MAY 1960
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CANADIAN ELECTRONICS ENGINEERING

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Precision casting solves waveguide design problems 26
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MAY 12 1960

Here's a NEW Booklet on Microwave Components — The facts and figures on many of Bomac's microwave components and test equipment are now available to you in a handy, easy-to-read booklet. Included are descriptions and specifications on: **Waveguide and coaxial line duplexers • Coaxial line monoplexer • Keep alive and recovery electrode supplies • Coaxial load • Variable power dividers • C-band R.F. package • Noise source • Waterloads • Coaxial line to waveguide transitions • Directional waveguide couplers • Magnetron test sets • Low level test set for spot display.**

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May, 1960

CANADIAN ELECTRONICS ENGINEERING

Volume four, number 5

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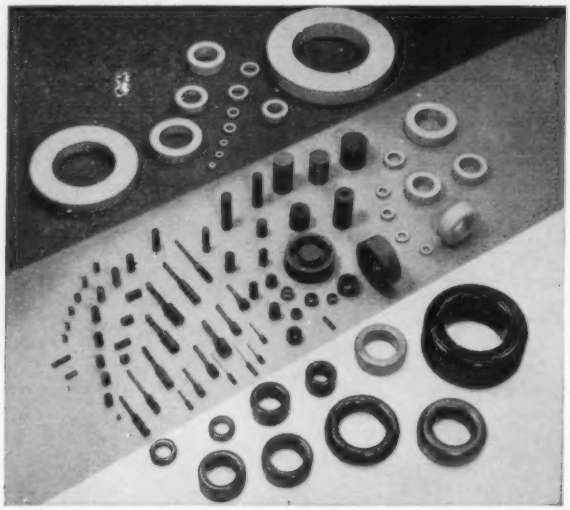
***cover design**

Lost wax casting is an art that has been used for many centuries by various craftsmen in different fields. In modern form it is helping to solve tricky design problems in electronics.

Specify "ARNOLD"

for your MAGNETIC CORE requirements

Top to bottom: Tape wound cores, Silectron C, E and O cores, and bobbin cores.



Top to bottom: Mo-Permalloy powder cores, iron powder cores, and Sendust cores.

SILECTRON C-CORES, E-CORES and TOROIDS Arnold C and E cores are made from precision-rolled Silectron strip in 1, 2, 4 and 12 mil thicknesses.

They are supplied in a wide variety of shapes, and in sizes from a fraction of an ounce to several hundred pounds. In addition to standard transformer applications, they may also be supplied for special applications such as saturable reactors, instrument transformers and pulse transformers.

Over 1,000 stock cores are listed in the Arnold Silectron catalog. A wide selection of preferred sizes are carried in stock for immediate shipment. For complete data on C and E cores and Silectron toroids, *write for Bulletin SC-107A.*

TAPE WOUND CORES of High Permeability Materials Arnold tape wound cores are available made of Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750 Electrical Metal, Silectron, or the new rectangular-loop material, Supermendur. All except Supermendur cores are available in standard tape thicknesses of 1, 2 and 4 mils; also in special tape thicknesses of ½ mil, 12 mil or other, as required or feasible. Supermendur is presently available in 4 mil cores.

Toroidal cores are made in 30 standard sizes with protective nylon or aluminum cases. Special sizes of toroidal cores are produced to individual requirements. *Write for Bulletin TC-101A. (TC-113A for Supermendur Cores.)*

BOBBIN CORES Arnold bobbin cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps to suit the ultimate use of the core in electronic computer assemblies. Magnetic materials usually employed are Deltamax and Square Permalloy in standard thicknesses of 1, ½, ¼ and ⅛ mil. Bobbins are supplied in ceramic or stainless steel. *Write for Bulletin TC-108A.*

MO-PERMALLOY POWDER CORES Available in a wide range of sizes, from .260" OD to 5.218" OD. They are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

These powder cores are supplied in four standard permeabilities: 125, 60, 26 and 14 Mu. They provide constant permeability over a wide range of flux density, and in many cases may be furnished stabilized to provide essentially constant permeability over a specific temperature range. Large warehouse stocks of preferred sizes are carried for immediate shipment. *Write for Bulletin PC-104C.*

IRON POWDER CORES A wide selection of cores is available, from simple cylinders to special cores of complicated design. The line includes all standard types of threaded cores, cup, sleeve, slug and cylindrical insert cores: for use in antenna and RF coils, oscillator coils, IF coils, perm tuning, FM coils, television coils, noise filter coils, induction heating and bombarder coils, and other low frequency applications. Preferred sizes are carried in warehouse stock for quick shipment. A standard series of iron powder toroids is also manufactured, conforming to the standard sizes proposed by the Metal Powder Industries. *Write for Bulletin PC-109.*

SENDUST POWDER CORES Available in a wide selection of sizes, ranging from .800" OD to 3.346" OD, and in permeabilities of 10, 13, 25, 30, 50 and 80, although not all sizes are available in all permeabilities. They possess magnetic properties generally superior to iron powder cores, but inferior to Mo-Permalloy powder cores in the audio and carrier frequency range. *Write for Bulletin SDC-110.*

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2V PERMENDUR . . . a ferromagnetic alloy of cobalt, vanadium and iron that possesses high flux density saturation properties. Its magnetostrictive properties are useful in many transducer applications. *Write for Bulletin EM-23.*

VIBRALLOY . . . a ferromagnetic alloy of nickel, molybdenum and iron whose temperature coefficient of elastic modulus is controllable over a wide range. It has high ferromagnetic permeability, and a rather high coefficient of magnetostriction. Used in applications where a zero or controlled thermo-elastic coefficient is desired.

BARIUM TITANATE . . . A piezoelectric ceramic widely used in accelerometers, phono pickups, microphones, ultrasonic grinding and cleaning devices and underwater signaling devices. For more information, *write for Bulletin CM-116.*

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authors and articles in this Issue

A. E. Maine (Solid-state inverter provides reliable emergency power) is celebrating an anniversary; his article on an inverter for an aircraft windshield heater supply appeared in the May 1959 issue of CEE. Mr. Maine is chief electronics engineer of the newly formed Special Products Division of the De Havilland Aircraft of Canada Ltd.

The current article describes a novel inverter using transistors in the switching mode, and provides excellent proof of Canadian capabilities in R & D. Mr. Maine's group is now working on the development of advanced solid-state inverters using silicon controlled rectifiers, which produce close approximations to sine-waves by means of staircase wave generation.

W. L. Haney (Precision investment casting solves waveguide design problems) has been faced with a production problem that plagues many design engineers. He has been engaged in projects involving the design of waveguide components, and had to find some way of producing them at reasonable cost. His experience could be very useful in many fields of engineering.

Mr. Haney was born in Winnipeg and graduated from the University of Manitoba during the depression. He has spent most of his life in the field of electronics, servicing radios, operating a radio system for a bushland airline, and with radio station CKY, Winnipeg.

In 1942 Mr. Haney joined the National Research Council to do radar development work and he is still engaged in that type of work. During World War II he spent two years on loan to Research Enterprises Ltd., Toronto. At present, he is head of Defence II Section, Radio and Electrical Engineering Division, NRC.

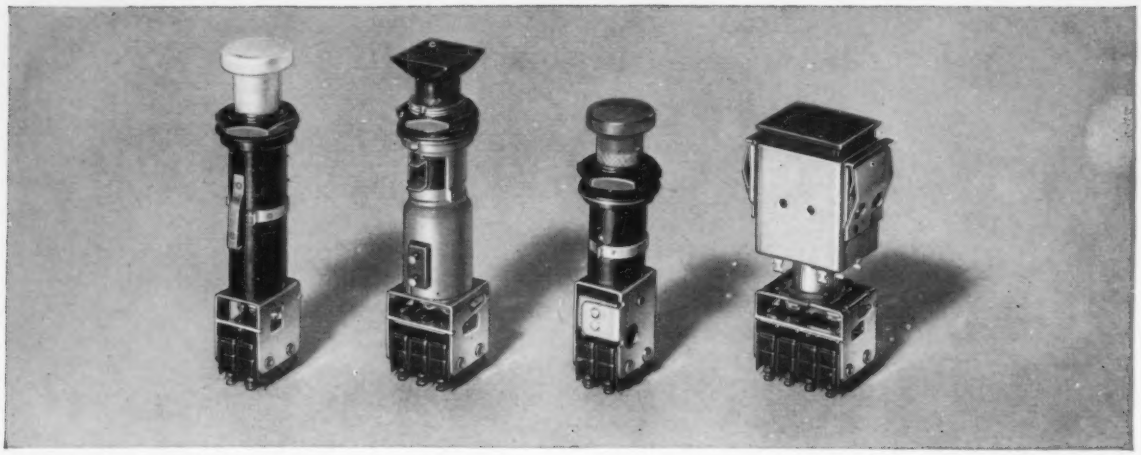
Magnetic recording techniques are assuming greater significance as the state of the art improves and broadcasters gradually replace obsolete station equipment. Now there is a definite trend toward automatic operation of broadcast stations.

C. S. Broad (Magnetic disc system permits automatic programming of broadcast stations) is working closely with broadcasters and knows their problems. He is marketing administrator, am products, RCA Victor Company Ltd. Mr. Broad has been with RCA Victor since 1953 and was, until recently, manager of technical field operations in Vancouver.

ARCHER

Broad

MICRO SWITCH Precision Switches



LIGHTED PUSHBUTTON SWITCHES—MICRO SWITCH manufactures a complete line of lighted pushbutton switches that saves wiring, cuts panel space. Available in momentary, maintained, alternate-action and magnetically held versions. Up to 4-pole double-throw circuitry and a choice of button sizes, shapes and colors. Write for Catalog 67.

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when you must be sure of Precision and Reliability

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"SM" SERIES—Small size, light weight and high electrical capacity. May be assembled into auxiliary actuator brackets, gang-mounted or used in pushbutton assemblies and rotary selectors. Precise operation and long life. Also available sealed in metal housings. Write for Catalog 63.

SUBMINIATURE MERCURY SWITCH—Ideal for locations where a minimum of operating energy is available. MICRO SWITCH manufactures over 1,000 different types of mercury switches, including enclosed models sealed in a resilient material with a protective case to guard against shock and vibration. Write for Catalog 90.

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SUB-SUBMINIATURE SWITCHES—Smallest single-pole double-throw, snap-action switches available, yet have ample electrical capacity and will give long, precise service. Write for Catalog 63.

For further information on these switches or for expert advice on any switching problem, call your nearest Honeywell office or write Honeywell Controls Limited, *Precision Components Division*, Toronto 17, Ontario.

Honeywell

MICRO SWITCH Precision Switches

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NEWS HIGHLIGHTS

Canadian National Railways plans to spend a total of $40 million on new signal and centralized traffic control equipment within the next few years.

CNR president Donald Gordon said that the railway has already spent $6½ million on such equipment and is planning to invest a further $6 million in 1960. The current program should require approximately $40 million before completion, accomplished in $6 million annual lots. The rates are based on availability of skilled technicians and materials. The returns on such expense should take the form of improved efficiency—in some cases, as much as 11%.

The Board of Broadcast Governors made the following changes affecting private commercial broadcasting station licenses in Canada:

(A) Transfer of ownership of a station, (B) Transfer of ownership or control of any share of the capital stock of a private company, either directly or indirectly, (C) Transfer of control of a station in any manner whatsoever. These changes may not take effect without Department of Transport permission based on approval from BBG.

New mode of operation has been discovered that may extend operation of transistors into the 8 Nc range.

A Lenkurt Electric Co. engineer, V. W. Vodicka has discovered a new mode of operation for transistors which appears to be a combination of tunneling and avalanche effects. Transistor manufacturers are now working on the problem and have obtained large increases in transistor bandwidth with greatly reduced noise. Indications are that they will soon have transistors operating in the 8 Nc region or higher.

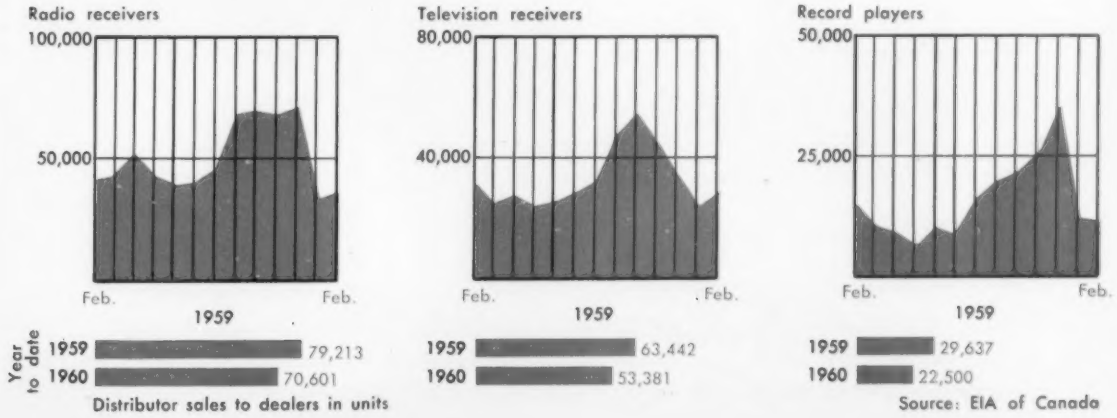
U. S. scientists are preparing to launch a balloon-type satellite to reflect radio signals between widely separated stations on earth.

The National Aeronautics and Space Administration announced that it will try to place a 100-foot diameter balloon-type satellite in an orbit 1,000 miles out from earth. It will follow an orbit between 50 deg. north and south latitude and be used to reflect radio signals between stations on earth. It could extend the range of tv communications.

Pressure is building up to get the green light on stereo broadcasting, but many U. S. companies fear anti-trust regulations, and FCC is swamped by all the proposed techniques.

Radio broadcasters and manufacturers have been waiting impatiently for the Federal Communications Commission to establish standards for stereo broadcasting in the United States. However, J. E. Barr, assistant chief of the broadcast bureau admits that FCC faces a bigger task than it can handle. It may deal only with fm initially, leaving am and tv stereo out of the picture for the time being.

Record player sales continue to drop; radio and tv recover slightly



Up to 5 megohms in a ½-watt resistor . . .
and better operating
characteristics, too!

Only the WESTON VAMISTOR®

offers performance like this!

Here, at last, is a precision metal film resistor which offers substantial advantages over all other types—wire wound, deposited film, etc. Look at this list of VAMISTOR capabilities and characteristics:

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- VAMISTOR OFFERS HIGHEST RESISTANCE RANGES. For example, 1.5 megohms in ¼-watt size . . . 5 megohms, ½-watt.
- VAMISTOR HAS OUSTANDING THERMAL CHARACTERISTICS. Runs cooler . . . resists thermal shock. Standard temperature coefficient doesn't exceed 50 ppm/°C.—lower than Nichrome wire. Also available with maximum of 25 ppm/°C. Temperature coefficients don't vary over the resistance range.
- VAMISTOR OFFERS UNUSUALLY LONG SHELF LIFE, STABILITY. Exclusive process of fusing element to inside of steatite tube assures long life, improved resistance to all environmental conditions.
- VAMISTOR IS MORE RELIABLE; HAS GREATER MEAN-TIME-TO-FAILURE.
- VAMISTOR PRODUCES NO CORONA; IS AS NOISE-FREE AS BEST WIRE-WOUND RESISTORS.
- VAMISTOR OFFERS EXCEPTIONAL PERFORMANCE UNDER RADIATION.
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- VAMISTOR IS VIRTUALLY NON-INDUCTIVE. Capacitance characteristics are superior to all other existing resistors.
- VAMISTOR IS SUBJECTED TO STRICTER QUALITY CONTROL THAN ANY OTHER RESISTORS.
- THE VAMISTOR LINE CONFORMS TO MIL-R 10509C CHAR. C. Styles RN-65, RN-70, RN-75 and RN-80.

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MIL STYLE	WESTON MODEL	WESTON DIMENSIONS	
		LENGTH	DIAMETER
RN-65, RI-92	9855-2	0.650	0.235
RN-70, RI-94	9852	0.866	0.312
RN-75, RI-96	9850-2	1.120	0.411
RN-80	9849-2	2.156	0.411

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Four Burndy men promoted as Co's expansion program gets underway

The expansion program currently under way at Burndy Canada Ltd., has brought promotion to four of the company's sales personnel.

R. H. Davies has been appointed to the company's Toronto head office as chief sales engineer. He has been with the company for over 10 years and was, until his promotion, industrial market manager.

John I. Croucher becomes eastern district manager, located in Montreal, with responsibility for sales in eastern Ontario, the Province of Quebec and the Maritimes. He joined the company two years ago after 11 years with Northern Electric.

R. W. Holliday has been appointed to the Calgary office as Alberta District sales manager. He is a member of the Association of Professional Engineers of Ontario and has been with the company eight years, most recently as utility market manager. He was previously with the H.E.P.C. of Ontario.

E. R. Friars is a new sales representative for the Maritimes and Newfoundland, and will be located in Halifax. He was born in New Brunswick and has been in the electrical industry for 13 years.

Engineering Institute elects Dick president

George McKinstry Dick, chief engineer of Canadian Ingersoll-Rand Company has been elected President of the Engineering Institute of Canada for the year 1960-1961. Formal induction will take place at the Annual Meeting of the Institute to be held in Winnipeg, May 25, 26 and 27, 1960.

Dick was born in Stirling, Scotland, and came to Canada in 1913. He attended Bishops University and later McGill University from which he graduated with degree of Bachelor of Science, honors in Mechanical Engineering in 1924.

He entered the employ of Canadian Ingersoll-Rand in 1915 as an apprentice and completed his education while on leave of absence. For many years he was Chief Hoist Engineer with the company and in his capacity pioneered in the design of many of the Mine Hoists used in Canada today.

He later became Technical Assistant to the Works Manager and held this position until 1945. In 1952 Dick was appointed Chief Engineer, a position he now holds.

GISLAU

Dick

Beattie

Manufacturer's representative

David R. Beattie, 1606 Chippendale Road, P.O. Box 585, Clarkson, Ontario (TA 2-1134) has been appointed Canadian representative by the following companies: Diamond Antenna & Microwave Corp. (waveguide components and accessories), Bamford Corp. (trimming potentiometers), Capcon, Inc. (mylar capacitors), Wilrite Products, Inc. (precision resistors), Norma (portable meters) (Ont. and Quebec).

Industrial electronics appointments

In recognition of his contribution in the field of industrial electronics, **G. Knapp** has been appointed assistant sales manager (industrial) of Aviation Electric Ltd. He will continue to co-ordinate all industrial sales activities, with emphasis on automatic control systems.

F. Mark, formerly associated with Davis Automatic Controls, in the capacity of division manager, has joined the Industrial Division of Aviation Electric Ltd.

B&I

Knapp

RICE

Adams

New projects chief at Philips Electronics

The professional equipment division of Philips Electronics Industries Ltd., has a new chief for its projects section. He is **Roy L. Adams.**

Adams has a background of research, development and production experience, with government and industrial organizations. He is an electrical engineering graduate of the University of Toronto and a member of Ontario Professional Engineers, the Canadian Aeronautical Institute and the Rotary Club of East York, Ont.

Canadian manager

Electro-Technical Labs, division of Mandrel Industries Inc., has named **Donald W. McCain** Canadian manager at the company's Calgary office. He succeeds **Thomas G. Gilbert** who has been transferred to Mandrel's Houston, Texas, division in a marketing management capacity.

WARNER

Davies

VAN DYCK & MEYER

Croucher

WARNER

Holliday

DODGE

Friars

The new concept of electronic equipment manufacture

A new philosophy

Made for everyday use

Wide range available

Modern techniques

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Automatic inspection *

Easy servicing

* An outstanding virtue of the new Philips electronic measuring tools for industry is that they give uniformily reliable and accurate results. Flow production, automatic inspection, eliminating operator error, ensure that this is so. To uniform reliability, add robustness in hard daily use under normal workshop or laboratory conditions and simplicity of operation. The sum of all these virtues is an entirely new conception of industrial electronic tools - by Philips, of course.

GM 5601
High Frequency Oscilloscope

Cathode Ray Tube. DH 10-78
Flat faced 10 cm tube, EHT - 1.7 kV
Vertical Amplifier: 0 - 5 Mc/s (- 3 ± ½ dB)
Sensitivity 100 mV/cm,
Calibration accuracy 3%
Time Base: 0.5 μsec/cm - 200 msec/cm
Calibration accuracy 5%
Horizontal magnification up to x 5
Internal trigger facilities up to 5 Mc/s

Quality, reasonably priced

Dependable **PHILIPS** *tools*

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Further information will gladly be supplied by:

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Leaside, Toronto 17, Ont. - Montreal: 8525 Decarie Blvd.

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Servomechanisms (Canada) Ltd. bought by Litton Industries

Litton Industries, California, has acquired Servomechanisms (Canada) Ltd. Rexdale operations. The Canadian subsidiary of Servomechanisms Inc. of Los Angeles has been engaged in the development and production of airborne electronic and electro-mechanical instrumentation.

Litton has expressed plans to expand the Canadian operation, placing particular emphasis on advanced guidance systems for the RCAF's CF-104 Starfighter.

Start work on Northern Electric research laboratories

Northern Electric Co. Ltd. has awarded Doran Construction Co. Ltd., Ottawa, a $2½ million contract for the first two buildings of the company's research and development centre at Ottawa.

Upon completion of this first stage, scheduled for 1961, a staff of about 200 will move into the new location. Northern Electric will increase personnel to approximately 400 in the following six or seven years.

With the construction of two more buildings, there will be later provision for future expansion as required.

Cohu names Tellurometer Canadian agent

Tellurometer Canada Ltd., Ottawa, has been appointed Canadian agent for Millivac Instruments, a division of Cohu Electronics Inc., Schenectady, N.Y. The Canadian company will be handling the complete Millivac line of precision measuring instruments.

General Radio Co. will be visiting companies in Ontario and Quebec this month with their traveling display of GR equipment. Hotel shows will be held in the Seaway Hotel, Toronto, May 7, and Capri Hotel, Montreal, May 15. Times are noon to 6 p.m.

New company manufacturing thermoelectric cooling devices

Needco Cooling Semiconductors Ltd. has been formed to manufacture thermoelectric materials and devices. It is a subsidiary of Nucleonic Electric Equipment & Development Co., both Canadian companies located at 5701 Cote Saint Paul Road, Montreal 20, Que.

The new company is affiliated with Semiconductor Thermoelements Ltd., and Infosearch Ltd., both of London, England. They have over twenty years experience in thermoelectric research and some of the development work at Semiconductor Thermoelements Ltd. has been financed by the Needco organization.

Needco Cooling Semiconductors Ltd. has a wholly owned subsidiary in the United States—Needco of America which, in affiliation with General Devices Inc., sells thermoelectric materials and devices through General Thermoelectric Corp.

Radio keeps tab on trains in Alberta and B. C.

A radio communications system, used successfully on the Royal Train during the Queen's visit last year, has been introduced by Canadian National Railways on trains operating in the mountain area of British Columbia and Alberta. By means of two-way radio, engineers and train crews can now communicate with each other, or exchange messages between trains in the same territory, and between trains and yard offices.

The radio link-up will soon be extended to provide contact between train crews and despatchers, selected operators' offices, track patrolmen and work gangs.

Honeywell Controls Ltd. recently introduced a new transistorized data processing system. Designed for a broad range of business applications, the Honeywell 400 rents for under $10,000 a month, including a central processor, four magnetic tape units, a card reader, and the high-speed printer shown above.

Ferrite manufacturing company formed

A new manufacturing company has been formed to specialize in the application of ferrites in electronics. It will be manufacturing bandpass and bandstop filters, low pass and high pass filters, tuned networks, oscillators, discriminators, pulse transformers and broadband transformers. Most of these will be in the range of 100 cps to 10 mc.

The new company, Ferritronics Ltd., has been formed by George G. Armitage. It is located at 157 Willowdale Ave., Willowdale, Ontario. Telephone: BA 2-1168 (Toronto exchange). Mr. Armitage was formerly engaged in the design and application of filters at Philips Electronics Industries Ltd.

Whittaker Electronics formed

Effective last month, Whittaker Electronics Ltd., 2137 Niagara Dr., Ottawa 1, took over representation of the firms previously represented by E. E. Whittaker. Stocks of several lines will be maintained at the Ottawa office.

Ottawa report

A running battle between Conservative MP Ernie Broome of Vancouver and CNR President Donald Gordon before a Commons committee has clarified the part of Canadian National Telegraphs in construction of a northern microwave system for the United States government.

Mr. Broome was particularly concerned over the subcontracting arrangements made in the deal by RCA Victor, after it was selected by the publicly owned CNT as the turn-key contractor for the project, which is to cost more than $25 million and be amortized over the next 15 years.

Demanded Mr. Broome of Mr. Gordon:

"Why is it your agents, RCA Victor, chose to give contracts over

Continued on page 47)

SOLA AC and DC voltage regulation

Continuous, automatic, maintenance-free

Sola Constant Voltage Transformers and Regulated DC Power Supplies provide dependable, regulated output voltage. Their output regulation is unaffected by wide variations in input voltage.

Sola CV Transformers are static-magnetic regulators with completely automatic, continuous regulating action. Their response to variations in input voltage is usually 1.5 cycles or less. They have no moving or renewable parts and require no maintenance.

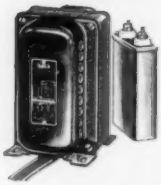
Each Sola Regulated DC Power Supply incorporates a constant voltage transformer in combination with a semi-conductor rectifier and a high-capacitance filter section. This combination makes the power supply compact, dependable, and efficient; and assures sustained output voltage in the face of pulse or intermittent loads, or heavy, short-time overloads.

Sola Constant Voltage Transformers

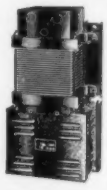
Standard Sinusoidal Type *provides voltage regulation of ±1% with primary voltage variations as great as ±15%. With less than 3% total rms harmonic content in their output voltage wave, these units are desirable for use with equipment having elements sensitive to power frequencies harmonically related to the fundamental. Available in nine ratings, 60va to 7.5kva.*

Normal-Harmonic Type *also provides ±1% regulation at somewhat less cost. This group has an average of 14% total rms harmonic content in its output voltages and is suited to equipment not extremely sensitive to voltage wave shape. The series includes those mechanical designs specially engineered for use as built-in components. Nineteen stock ratings range from 15va to 10kva.*

Adjustable Sinusoidal Type *provides ±1% regulated voltage output—one output adjustable from 0-130 volts and one fixed at 115 volts. Has less than 3% total rms harmonic content in output voltage. Portable for use in shop or laboratory, or mount on standard relay rack.*



Electronic Power Type *regulators provide ±1% regulated filament voltage at 6.0 and 6.3-volt levels; or a combination of plate and filament voltages regulated ±3% for ±15% input variations. Filament regulators are available in ratings from 2.3 to 25 amps. One model is specially designed for portable lab or shop bench use; it has a 30va rating. Combination plate/filament regulators, in three stock sizes, are designed to operate with commonly-used rectifier tubes.*



Custom-designed units *can be supplied in production quantities in ratings from 1va to 25kva to suit individual specifications. Custom designs can include special mechanical structures, various voltage ratios, special frequencies, compensation for frequency variations, multiple output voltages, three-phase service. Units can be manufactured to military specifications.*

For additional information on Sola Constant Voltage Transformers, write for Circular 52E-CV

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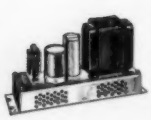

Fixed-output-voltage designs *are available in six stock models with ratings from 24v @ 6a to 250v @ 1a. They are extremely compact, light-weight, and moderately priced in proportion to their power output and performance.*

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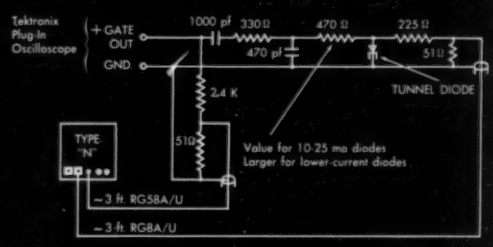
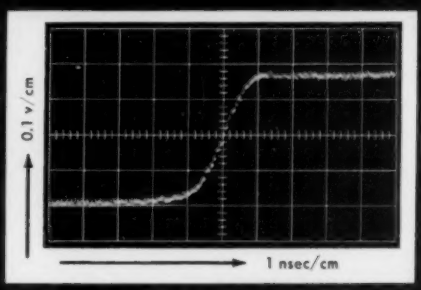
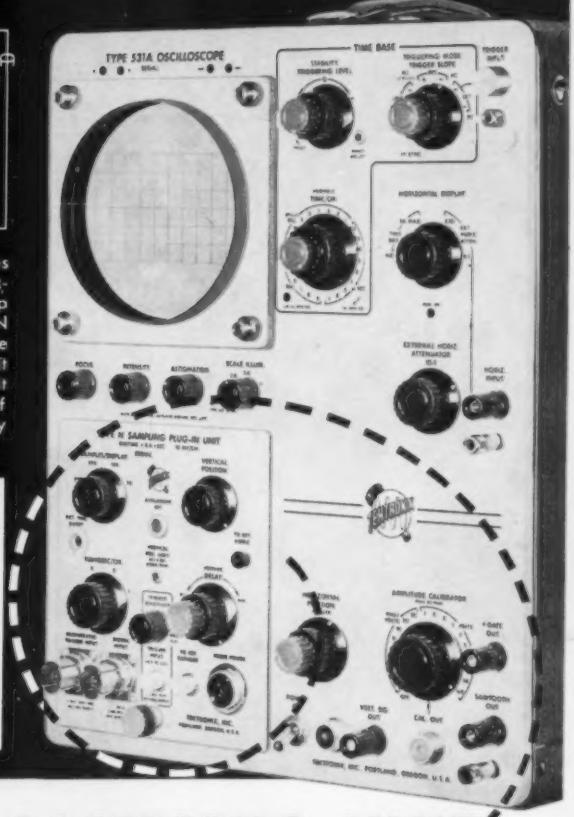
Tunnel Diode Switching Time Measurement

with Tektronix Type N Sampling Plug-In Unit



A convenient low-cost method of testing tunnel (Esaki) diodes with nanosecond switching speeds is shown above. A Tektronix Plug-In Oscilloscope provides both the current ramp source for the tunnel diode and the pretrigger for the Type N Unit. The N Unit is set up in the usual way — however, the oscilloscope main sweep generator is allowed to free run at 1 μsec/cm. The + GATE OUT not only triggers the N Unit but also provides a delayed current ramp with a low rate of change—which allows the tunnel diode to switch at essentially its own rate.





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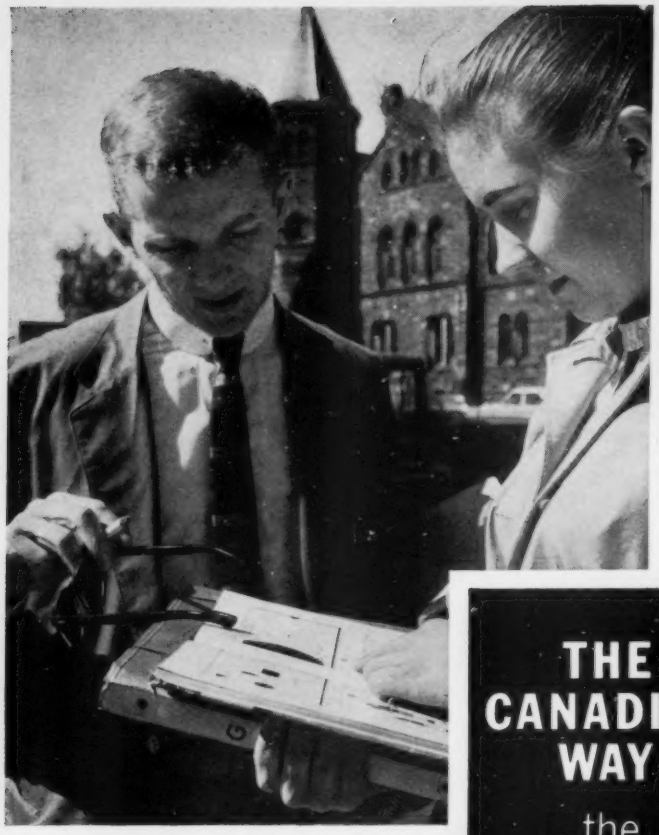

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OC58	General purpose subminiature
OC59	General purpose subminiature
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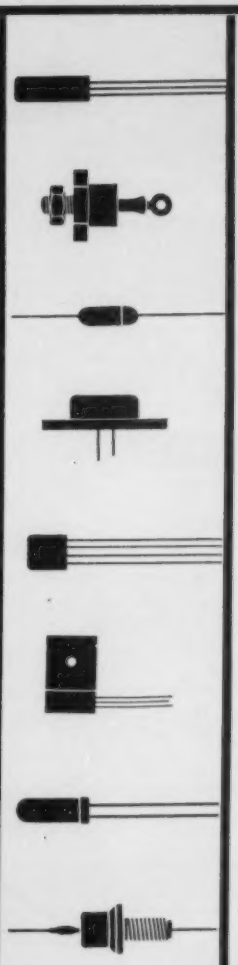

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OA81/1N476	High voltage general purpose.
OA81C/1N477	Clip-in version of OA81/1N476.
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OA85C/1N479	Clip-in version of OA85/1N478.
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OA86C/1N119	Clip-in version of OA86/1N480.
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OA91/1N617	Subminiature OA81/1N476.
OA95/1N618	Subminiature OA85/1N478.
1N126	Subminiature JAN diode.
1N198	Subminiature JAN diode.

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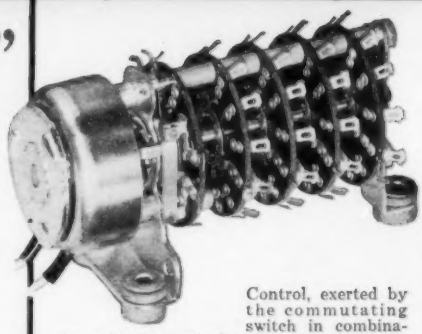

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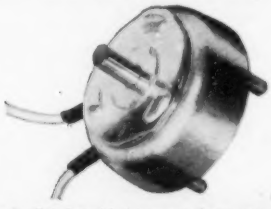

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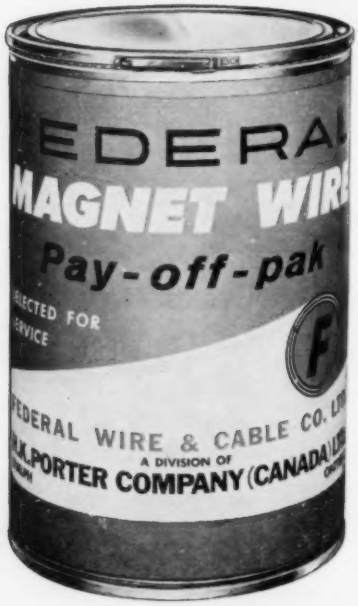

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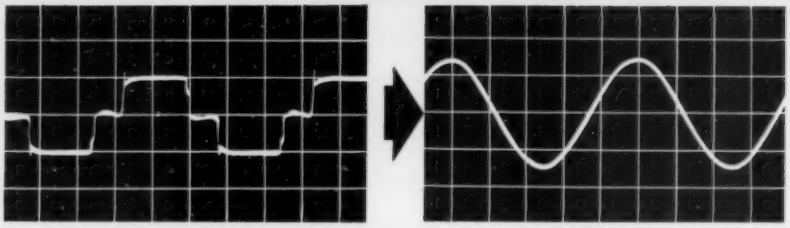


Solid-state inverter provides reliable emergency power

A new solid-state inverter has been developed to provide an emergency power source for a ship's gyro compass. It has high efficiency, and the use of transistors in a switched mode enhances its reliability. The inverter includes a novel phase lock circuit, and is typical of equipment that can replace rotating machines in many applications

A. E. MAINE*

Once the gyro compass of a ship has run up and established its terrestrial reference, it is important that it is maintained in an operating condition while the ship is under way, since interruptions of the gyro supply may involve periods of up to 1½ hours before its true heading is re-established. For this reason it is usual to provide an emergency electrical supply that will quickly take over the gyro load in the event of temporary failure of the ship's normal power system. It also follows that to reduce disturbances to the gyro to a minimum the changeover from normal to emergency supplies should be accomplished automatically.

The emergency energy source for the gyro is a 24 vdc battery, specially provided for the purpose; the power required by the gyro is 400 cps 3-phase ac. An inverter device is therefore required to convert from direct to alternating power. Since it is undesirable that the standby battery should be excessively large, the inverter should have a good over-all efficiency. Completely overshadowing this requirement is the insistent need for extreme reliability: a long and hard look has therefore been taken at the customarily used rotary inverter.

A frequently used and well-maintained rotary inverter can be very reliable. But a machine operated only occasionally, with idle periods of a year or more, may possibly be overlooked on the maintenance schedule of a large and complex ship's electrical power system. "Freezing" of bearings, sticking of brushes, formation of layers on the commutator, and sticking of carbon-pile regulators are a few of the problems that beset rotary machines used infrequently. These considerations, coupled with the poor efficiency of rotary machines, led to the choice of the solid-state static inverter described in this article. To ensure reliability every component has been very conservatively rated, over-all size being a matter of secondary importance.

*Chief Electronics Engineer, Special Products Div., The de Havilland Aircraft of Canada Ltd., Downsview, Ont.

Basic operation

Figure 1 is a simplified block diagram of the static inverter. Two similar channels deliver outputs in quadrature that are converted to a symmetrical 3-phase system by means of the well-known Scott transformer connection. The choice of a 2-channel rather than a 3-channel system was determined on the basis of circuit simplicity and the ratings of available power transistors. At a very conservative switched mode of operation two pairs of Delco 2N174 transistors are adequate to provide the 240 va needed by the gyro equipment.

Referring to Figure 1, a sine-wave oscillator supplies a signal at 400 cps to the modulator stage, which in response to a dc control signal produces a width-modulated square-wave output that fully switches the power stage. The resultant 400-cps fundamental component of the power stage output is extracted, the harmonics being suppressed. The second channel operates in the same way, except that its output is displaced 90 deg. by the phase shifter at the input.

Voltage regulation of each channel is effected by varying the pulse width of the signal produced by the modulator, which in turn varies the amplitude of the output

Solid-state inverter for emergency power

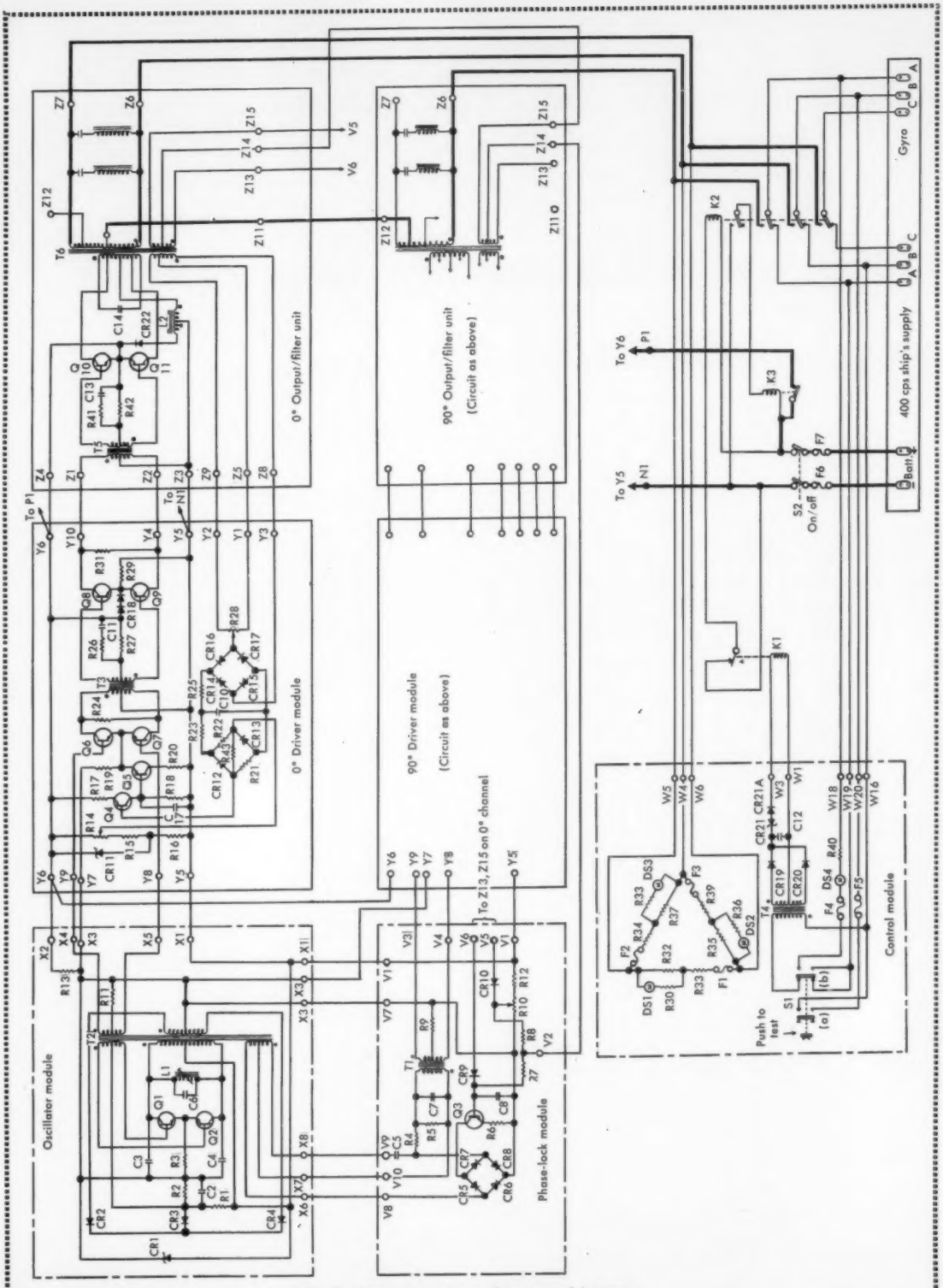


Fig. 2. Complete circuit diagram of inverter

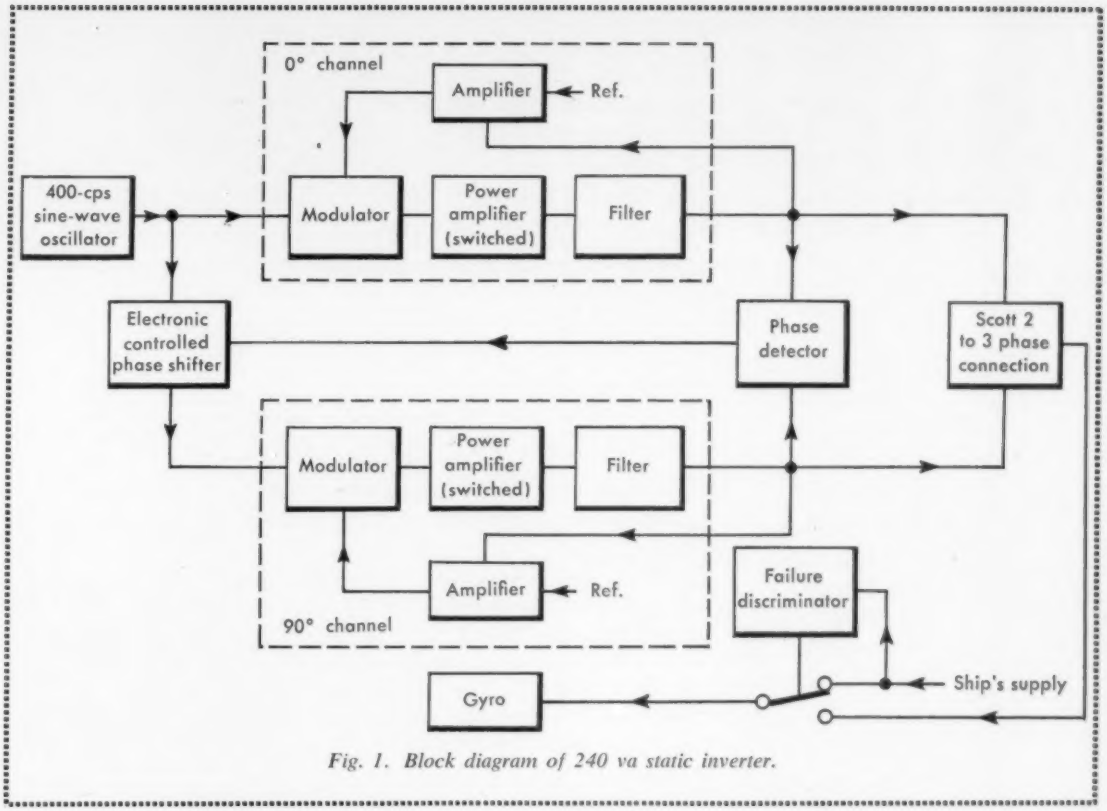


Fig. 1. Block diagram of 240 va static inverter.

fundamental component. A stable reference voltage and dc amplifier in conjunction with the measured line voltage produce the control signal applied to the modulator. The switched mode of the power amplifier results in a very high conversion efficiency not attainable with linear systems and normal Class B amplifiers.

To keep the 3-phase output from the Scott connection truly symmetrical even with unbalanced loading, it is essential to maintain a true quadrature relationship between the two channels at all times. This is accomplished by connecting a 90 deg. phase detector at the 2-phase side of the inverter and using the resultant error signal to adjust the phase shift produced at the input to the second channel. This automatic phase-lock arrangement, in association with the close voltage regulation, ensures a symmetrical 3-phase output for all operating conditions.

To complete the inverter, a "ship's supply failure relay" is provided which at a predetermined undervoltage switches in the inverter and connects the gyro to the inverter output terminals. When the ship's supply resumes its normal state, the inverter is automatically cut out. A simple test circuit and neon lamp monitors are also provided to give an indication of the operational status of the gyro supply.

400-cps oscillator

Since a frequency tolerance of 3% was judged satisfactory it was possible to dispense with the more complex fork- or crystal-controlled oscillators commonly used and employ instead a fairly conventional LC type of push-pull configuration.

The circuit arrangement of the oscillator is shown in the upper left hand part of Figure 2. In normal operation the transistors Q1 and Q2 operate under Class C bias conditions. The frequency-determining elements take the form of a permanent magnet biased inductor L1, in parallel with the output transformer inductance and the capacitor C6. Adjustment of the magnet bias alters the total inductance of the circuit and permits the operating frequency to be set.

For reasons concerning the operation of the subsequent modulator stages it is necessary that the oscillator be amplitude-stabilized. This is accomplished in the following way: Diodes CR2 and CR4 apply successive half-waves of the output to the reference diode CR3. The difference voltage between the half-waves and the reference voltage charges the capacitor C2, the time constant of the circuit being such that near-peak rectification occurs. Should the output voltage tend to rise, the bias error voltage across C2 also rises and the transistor conduction angles therefore decrease; this reduces the fundamental amplitude and a new stable state is reached. A converse mechanism applies if the output amplitude tends to fall. To reduce further the possibility of amplitude disturbances, the entire oscillator is supplied from a steady dc voltage furnished by the Zener regulator diode CR1.

Solid-state inverter for emergency power

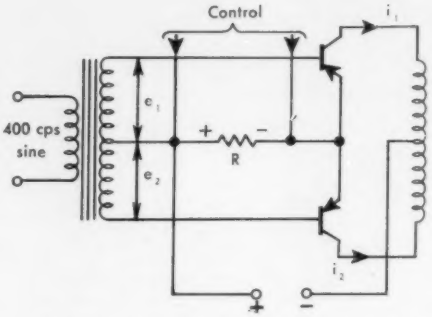


Fig. 3(a). Simplified modulator circuit.

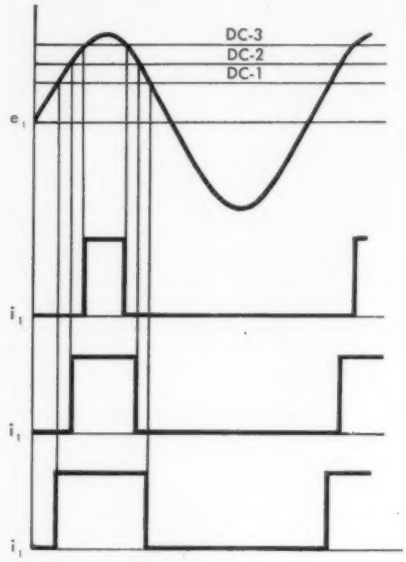


Fig. 3(b). Idealized modulator waveforms.

Pulse modulator

The principle of the pulse modulator is best explained by reference to the simplified circuit shown in Figure 3(a). If it is assumed that there is negligible voltage drop across the resistor R due to base and emitter currents, then the stage will behave as a normal Class B amplifier when an ac signal is applied to its input terminals. If now a bias voltage is developed across R from an external source with the polarity shown, conduction in either transistor is only possible when the instantaneous ac voltage exceeds the steady voltage value, and conduction will cease when the ac voltage drops to the bias voltage value later in the cycle. By varying the bias voltage from zero to the peak value of the applied ac wave, continuous control of the conduction angle from 180 deg. to zero is possible.

In the actual modulator circuits used, the base drive in association with the effective collector load resistance is chosen such that the stage quickly becomes saturated after the onset of conduction; this has the desirable effect of squaring up the output waveform. Figure 3(b) shows idealized pulse shapes applicable to three different values of bias voltage. It will be noticed that because of the symmetrical mode of operation, the centres of the pulses are aligned with the peak of the applied sine-wave. This particular type of modulator does not produce instantaneous frequency changes and therefore contributes to the over-all stability.

Driver stage

The driver stage circuit is shown in the upper central part of Figure 2; once again, it is a simple push-pull amplifier. As with the modulator, the base drive current and collector effective circuit resistance are arranged so that the stage operates in a switched mode and produces output pulses with very fast rise and fall times, in the region of 10 usec.

A difficulty experienced with transformer coupled switched amplifiers concerns the dissipation of stored magnetic energy in the drive transformer at the time the preceding stage transistors cut off. If no means are adopted to prevent undesirable effects, the collapsing flux in the drive transformer, say T3, will result in the premature partial turn-on of one of the driver transistors. This "pre-saturation platform" is amplified by the driver stage and applied to the output transistors, which will also operate in the unsaturated condition. Immediately this occurs, drastically increased power dissipation takes place in the power transistors that results in gross overheating.

To avoid this effect, three circuit additions are made. The first is the connection of a discharge resistance R24, across the primary of the driver input transformer T3; this reduces the induced voltage to an acceptable level. The second addition consists of a current fed diode CR18, joined in the common emitter circuit; the forward voltage so developed opposes the fly-back voltage and tends to prevent the flow of spurious base current. The third circuit modification is the introduction of the dual-purpose network R26, R27 and C11. In action, when either of the driver transistors have ceased conduction, a charge is left on C11 which further opposes the fly-back voltage. The secondary role of the network is to give a slight speeding up of the turn-on time when the true signal is applied. Employment of these three measures ensures that the driver transistors are positively reverse-biased during the nominal off periods.

Power stage

The fly-back voltage problem described for the driver stage also applies to the power stage. Except for the current-fed diode, which at the much higher emitter currents would involve a serious power loss, the same preventative techniques are used. Referring to Figure 2, the discharge resistance is R31 and the RC network is formed by R41, R42 and C13.

Since the power filter system is intimately tied up with the circuit configuration of the power stage itself, it is desirable to consider the two together. First, however, some attention should be given to the harmonic content of the pwm waves; Figure 4 indicates the variation of fundamental and harmonic terms as the modulation angle is varied. It is evident that the distribution of harmonic

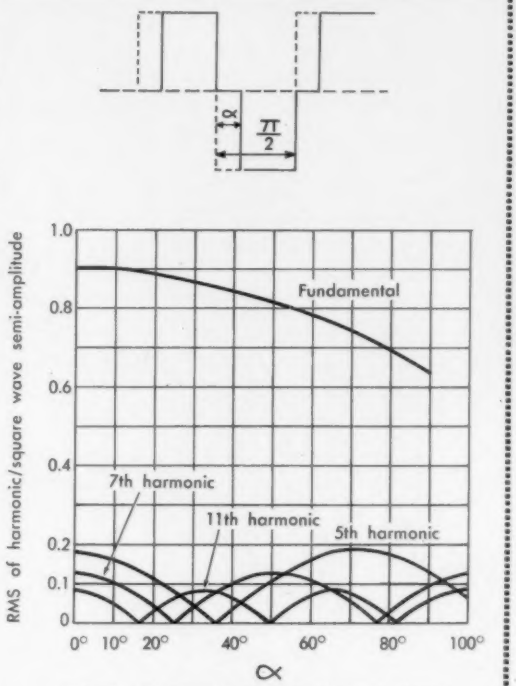


Fig. 4. Harmonic contest of pwm waves.

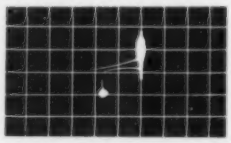


Fig. 5. Collector voltage-current locus for output transistor

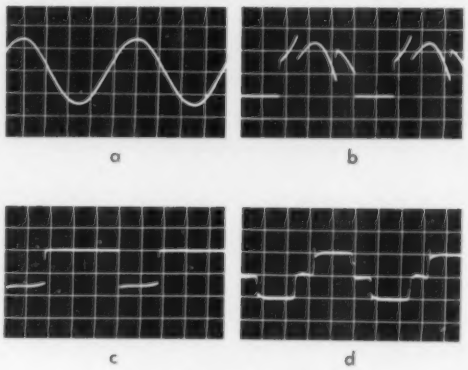


Fig. 6. Typical waveforms

(a) Output voltage *(b) Collector voltage*
(c) Collector current *(d) Drive voltage*

amplitudes presented to the filter system varies widely with the modulation angle and that the fundamental component varies as the cosine of half this quantity. The latter variation is the important one and enables voltage regulation to be effected.

Turning for a moment to the operation of the power transistors themselves, it is essential that during "on" periods the base current supplied is sufficient to drive the transistors far into collector saturation. During the "off" periods the bases should be slightly reverse-biased from a low impedance source. These conditions, loosely termed Class D operation, speed up the collector current rise and fall times, help prevent thermal runaway, and reduce both transient and quasi-steady-state loss terms. A properly driven power stage using Delco 2N174 transistors and working into an optimized filter system should typically result in total power dissipations of not more than 3 or 4 watts per transistor for peak collector currents of up to 10 amps.

The collector current, voltage and dissipation conditions during actual operation may be assessed by displaying on an oscilloscope the collector operating locus. This is done quite simply by applying the collector-emitter voltage to the X-axis and the collector current (using a low-valued sampling resistance) to the Y-axis. Ideally, all operating points should lie on the perpendicular axes, any excursions into the adjacent quadrant being indicative of transient power loss. The trick in power stage design is to limit the excursions to regions around the origin and reduce their duration so that the power dissipation integrated over the duty cycle is equal to or less than the quasi-steady-state value. An illustration of an acceptable operating locus applicable to this inverter is given in Figure 5.

In regard to power-stage configuration, the grounded emitter stage has the considerable advantage of requiring the minimum drive, but requires that the collectors be insulated from their heat sinks. In this application there is no real restriction in regard to heat sink size, so the extra thermal resistance introduced by the thin mica insulating sheet is of no great consequence. Even in cases where volume is at a premium, the grounded emitter arrangement is usually preferable because of its reduced drive requirements.

Filter system

The design and optimization of the filter is probably the most inscrutable aspect of the whole inverter design since, in association with the switched amplifier, it constitutes a highly nonlinear system, not really amenable to analysis or synthesis by manual methods. The application of linear theory, however, identifies some of the ground rules and it is possible to develop a satisfactory filter system for any given application. Whatever filter arrangement is chosen, and there are several possibilities, it must satisfy two requirements: the filter must produce an output waveform that meets the harmonic distortion specification over the load range, and it must not react on the power stage in a damaging way.

In this inverter, the 2-stage low-pass filter configura-

Solid-state inverter for emergency power

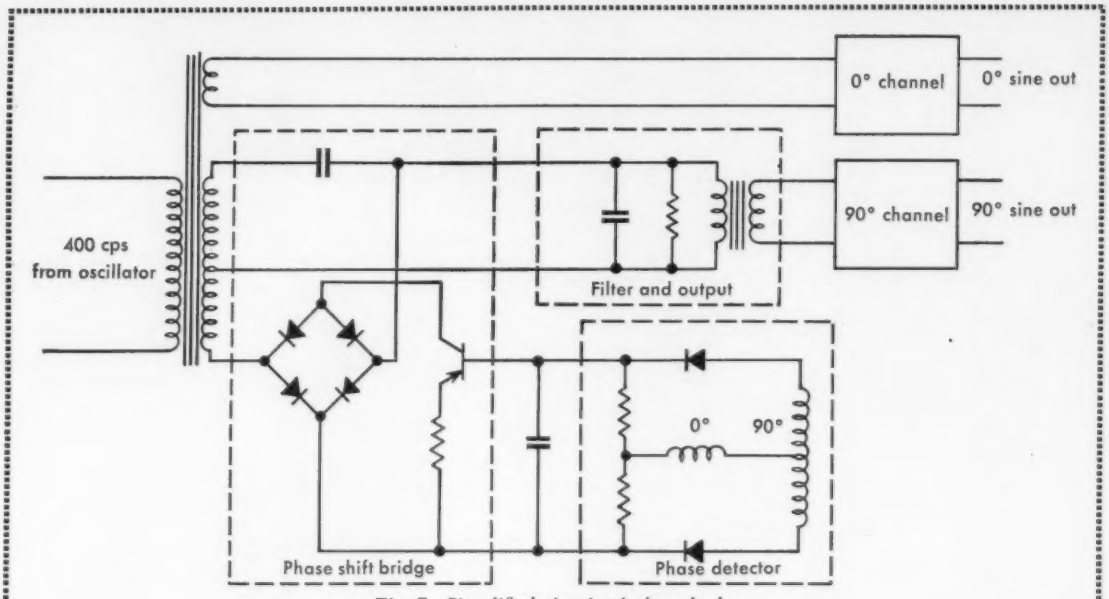


Fig. 7. Simplified circuit of phase lock.

tion with resonant shunt paths was chosen, with the first inductive leg on the dc input side of the power stage. The dc choke also serves as a spike-suppression element and is provided with a diode discharge circuit to avoid the generation of severe voltage spikes on the collector voltage waveform. The first shunt capacitor is joined across extending taps on the primary of the output transformer; the second series leg is provided by carefully controlled leakage inductance in the output transformer itself, which is of special design. The final shunt path comprises two series resonant filters tuned to the 3rd and 5th harmonics respectively.

The whole filter presents a predominantly capacitive reactance at the fundamental frequency to the transistors, this being an important requirement both in regard to eliminating unfavorable reaction on the transistors and for the purpose of supplying reactive power to the load. Figure 6 shows the output voltage and related waveforms at full load employing the filter system described; the good waveform is maintained over the required load range.

Voltage regulation

Voltage regulation is carried out at the 2-phase side of the inverter, using two identical regulators. In each case a part of the filtered output is rectified and the resultant dc voltage applied to a long time constant integrator (R23, R25 and C10, Figure 2). This network provides good smoothing of the signal but more importantly acts as a shaping network to provide system stability. The smoothed signal is passed to a Zener-diode bridge type detector, and the resultant error signal passed on to a two-transistor dc amplifier consisting of a grounded emitter stage and an emitter follower. The load resistance of the emitter follower is incorporated into the sine-wave driven modulator stage and provides the dc level to determine the pulse-width of the modulator output. Even though the main output filter is included in the forward path of the loop, fast stable action of the regulator is assured and the line voltages are easily held to $\pm 3\%$ for all conditions of load and dc input voltage.

Phase lock

Figure 7 shows a simplified circuit of the phase-lock device. The phase-shift circuit is essentially a bridge-type RC arrangement, but with the resistive arm replaced by a transistor supplied by a bridge rectifier. The transistor is, of course, far from being a linear ohmic resistance and consequently considerable harmonic distortion is present in the output signal. However, the all-important phase-shifted fundamental component can be isolated by tuning the output transformer with a shunt capacitor. To avoid a rapid phase change with frequency, the "Q" of the parallel circuit is deliberately reduced by a shunt damping resistor.

To complete the phase-lock loop, a simple half-wave phase detector is connected to the two 2-phase outputs. If a true quadrature relationship exists, no dc correction signal is applied back to the transistor controlled phase-shifter. Should a phase error develop, the phase detector passes a dc signal of appropriate polarity to the controlled phase-shifter, which, crudely speaking, alters the effective resistance in the RC bridge to re-establish the required quadrature condition. In practice, the phase-lock circuit maintains the 2-phase outputs at 90 deg. to within $\pm$ 2 deg.

Automatic power transfer

The relay control circuits of the inverter are very simple; operation hinges upon the action of the sensitive relay K1 (see Figure 2). This relay is normally held operating by the voltage produced by a rectifier joined across phases A and B of the ship's 3-phase supply. A

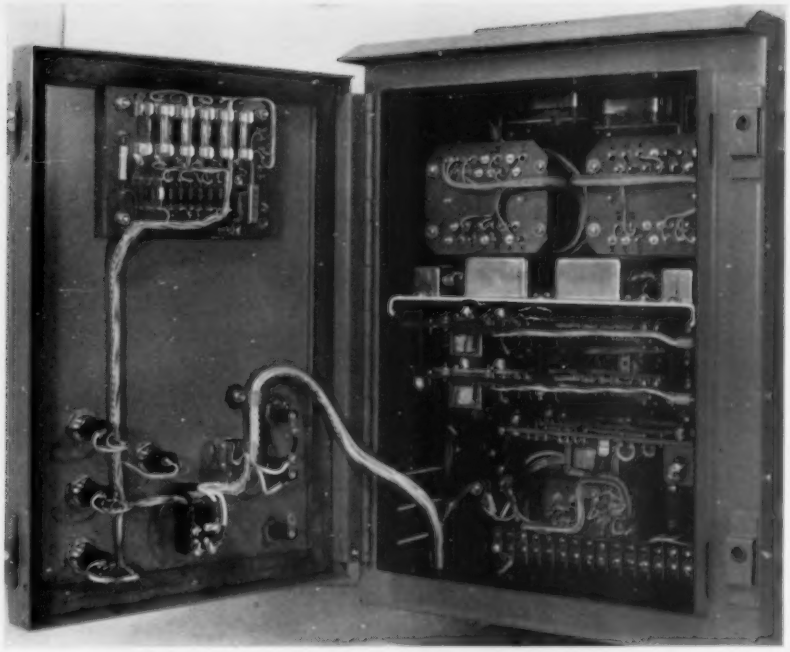


Fig. 8. Photograph of complete transistorized static inverter, showing division of cabinet into two separate thermal regions, with control and indication components mounted on cover.

Zener diode is included in the relay circuit and this provides the sharp voltage-sensitive action needed to ensure that the relay positively drops out should the line voltage fall to three quarters of its nominal value or less. When this happens, relays K2 and K3 operate and the inverter assumes the load. Should the ship's supply be restored, K1 operates, K2 and K3 drop out, and the ship resumes supplying the load, the inverter being turned off.

To check the operation of the inverter, a push-button switch S1 is provided that when depressed simulates a supply failure by breaking the feed to the rectifier supplying relay K1. At the same time, extra contacts on the push-button switch connect a neon indicator between the ship and inverter 3-phase systems enabling the frequency difference to be estimated by observing the rate of blinking of the neon indicator. Finally, 3 neon indicators, one per phase, are provided so that the inverter line voltages may be judged present and reasonably near to their proper value as estimated by the intensity of glow.

Mechanical arrangement

The static inverter is required for bulkhead mounting on board ship and this determines the use of a standard enclosure with hinged lid and drip-proof construction. It is also a requirement that all the internal assemblies and components be accessible and removable without demounting the enclosure from the wall. To meet these requirements and at the same time provide for easy manufacture and servicing, all of the inverter, less the power stages and relays, has been accommodated on a number of circuit boards, each being an essentially complete functional module.

The influence of thermal considerations on over-all design is manifest in a number of ways. A reflective heat barrier divides the box into two parts, the upper part housing all the dissipative items such as chokes and output transformers, and the lower part accommodating the low-power control modules and relays. The power transistors are mounted in pairs on robust finned and black-anodized heat dissipators bolted directly to the box sides. Louvers above and below these dissipators provide a good convection path into and out of the box and through the dissipators and also underneath the ¼-in.-thick aluminum main mounting plate. This plate is stood off ¾ in. from the bottom of the box by good thermal contact spacers. The inside of the box is finished matt black so that internally radiated heat may be easily transferred to the box walls for dissipation by external convection and radiation. All heat-producing components are so mounted that good conduction paths to the main mounting panel are provided.

The general appearance of the completed inverter is shown in Figure 8; the division of the box into the two thermal regions is clearly visible.

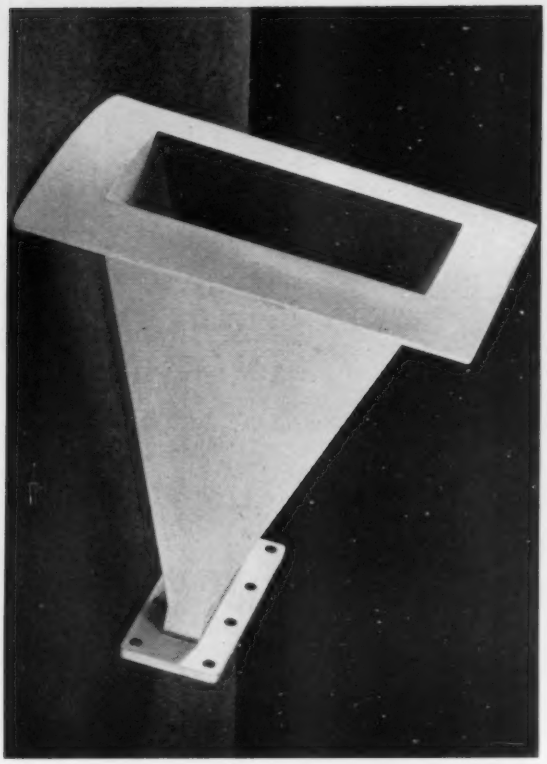
Conclusions

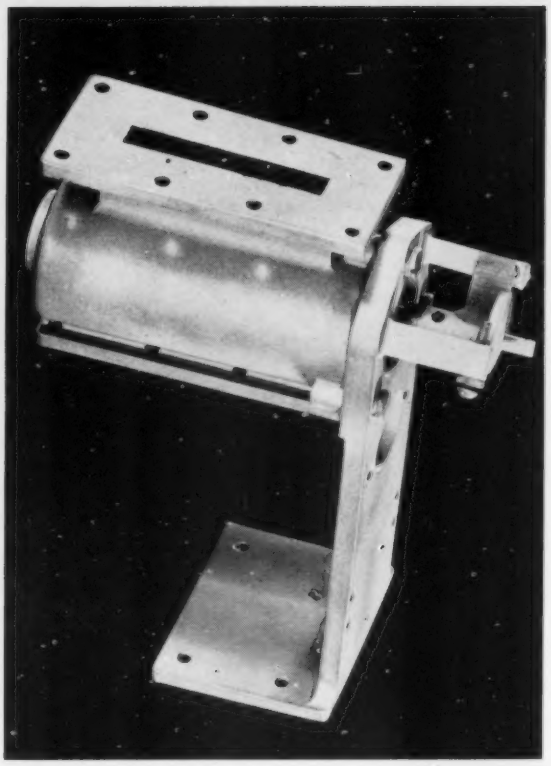
This inverter, rated at 240 va continuous duty with good voltage regulation, frequency stability, and output waveform, operates at a conversion efficiency of over 75% and a power factor of 0.8 at full load.

Though considerably larger than similar inverters presently available for aircraft usage, the unit described nonetheless employs advanced techniques and is probably typical of the class of static solid-state devices which on an ever-increasing scale will ably replace rotating machines in many branches of electrical engineering in the future.

Acknowledgement

The author wishes to thank The De Havilland Aircraft of Canada, Limited for permission to publish this article; he also wishes to acknowledge the valuable contributions of D. Lewis and I. Rowe, both of the Special Products Division, who participated in the design. END





Precision investment casting solves

This ancient method of casting, used by the Egyptians five thousand years ago to make bronze statuary, is now used to make parts for radar equipment, jet aircraft and rockets. Heat resistant alloys can be precision cast by the "lost wax" method to make hollow parts such as waveguide components. Modern refinements make possible the solution of many microwave design problems. This use of the process is discussed in the paper.

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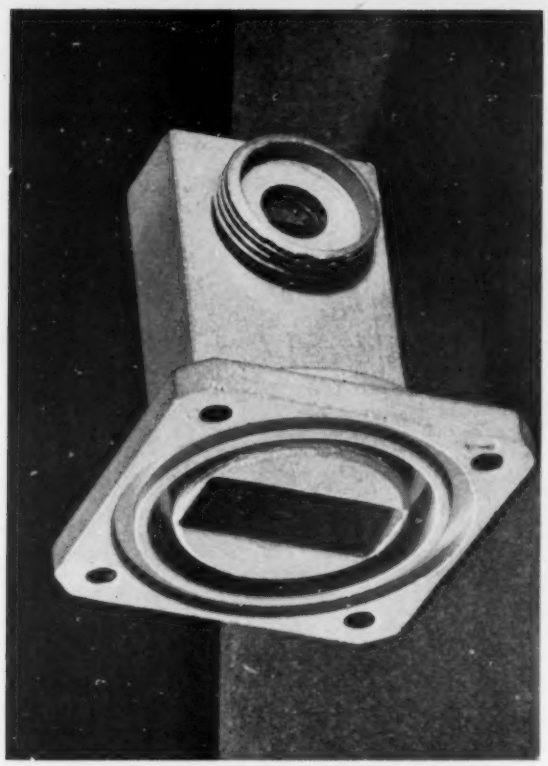
Nearly every process of working metal has been used to make microwave components. Each method has special advantages and corresponding disadvantages. Machining is precise, but costly. Electroforming is also precise, but not suitable for large quantities. Sheet metal work is not costly, but is usually inadequate on tolerances. Conventional casting is not precise enough. Die casting is precise, but too costly for short runs. Investment casting is precise enough for many purposes, is relatively inexpensive, is suitable for both large and small quantities, and so may make a good engineering compromise.

Investment casting is also known as "lost wax" casting, and as precision casting. Briefly, the process is to make a wax model of the device by casting the model in a machined die. The wax model is then surrounded by the investment material, a slurry in semi-liquid form. The wax model in the investment is then heated in a furnace, which hardens the investment and melts the wax, which is run off. This is the origin of the name "lost wax". The molten metal is then poured, under pressure, into the refractory mold, in place of the wax. The molten metal is then allowed to set. After setting, the refractory mold is broken away leaving a metallic replica of the wax model.



waveguide design problems

This method, although unfamiliar to most electronics engineers, is very ancient. It is known to have been used by the Egyptians for casting art work in bronze as early as 3000 B.C. In more recent years, it has been used by jewelers, and by dentists for casting gold fillings and inlays.

The properties which make it very attractive for the making of microwave components in both small and large numbers is the relatively low cost of tooling and processing, along with the relative precision obtainable. The die, which is usually made of aluminum, brass, or steel by conventional machine methods, is good for many thousands of pieces. Small changes are readily made during the development period, at relatively low cost. Tolerances are usually ±0.004 in. per inch on dimensions greater than one-half inch, up to about 6 in., which is often a maximum on any one dimension. A weight limit of 5 to 10 pounds is usually applied. On smaller dimensions the tolerances drop slightly, being ±0.002 in. at ⅛ in. dimension.

Investment castings hold close tolerances

The name precision is with reference to other casting methods, as this process is not "precision" in the machining sense. However, while the tolerances may seem large, they may not be so in the finished article. This follows because the finished article will often be cast in one piece while other methods may require many pieces, with a large cumulative tolerance.

Components made by processes using heat, such as hard soldering, may have poor tolerances because of distortion, resulting from differential expansion. This can occur in the casting process, but, with proper design and a skilled founder, the distortion can be controlled and superior tolerances can be achieved. Similarly, in processes in which the metal is drawn, as in bending waveguide, tolerances will be poor because of distortion. This type of distortion does not occur in investment casting.

This method is not suitable for the production of equipment of the highest standard, such as slotted lines, precision attenuators and other measurement devices, because of the tolerances required. It is doubtful that the method can be used for frequencies above 10 Gc*, without additional machining. We have had components cast for use at up to 20 Gc but have felt it necessary to machine the internal dimensions. The machining required can be both

*Gc is gigacycles (10^9)

simple and small in quantity if this is considered in the initial design. For example, broaching of waveguide sections has been done with little difficulty. Above 20 Gc, it is unlikely that this process can be used because of the very small internal dimensions, making casting difficult.

The ability to make most of a waveguide component in one piece will frequently represent large savings in machining costs, because many machine operations may be avoided. Assembly costs may be reduced since flanges, chokes, mounting bosses, branch circuits, and so on can be an integral part of the casting, thus avoiding brazing or soldering. Slots and holes may be cast in place, although machining may be necessary if the precision required is high, or the hole or slot small, or narrow. Microwave parts made by this method can often be designed to carry mechanical loads as well as perform their electrical function. The rigidity and light weight and strength of the casting make this possible. Stock numbers, or other identification may be readily cast in place at little extra cost.

One feature of the method which simplifies design is the ability to form various parts of the wax model independently, and "solder" them in place while still in wax. This procedure may result in poorer tolerances, but may simplify the die and therefore lower the cost considerably. In any case, it adds greatly to the versatility of design: many designs are impossible to cast by other methods.

Aluminum alloy is used for casting components

The alloy often used is AC125/T6. This metal is a general purpose aluminum casting alloy, frequently used for aircraft parts. Another suitable alloy is AC135/T6. It is similar to AC125/T6, but is said to have superior resistance to corrosion. The designation for these alloys is that used by the Aluminum Company of Canada Ltd. The T6 portion of the designation specifies the heat treatment; in this case a full solution heat treatment with artificial aging to follow. It is a method of treating aluminum castings to obtain the greatest mechanical strength in the finished work. These alloys can also be artificially aged by a treatment known as T51. In this case the mechanical properties are less than the maximum and, of course, are less costly. These alloys may be welded, but not brazed or hard soldered. They can, if necessary, be soft soldered, using a glass brush as an abrading tool.

The external surface of waveguide parts is sand blasted and may have whatever decorative finish is required. It is preferable to leave the internal or electrical surface as cast. The internal finish is, to some extent, determined by the alloy used, by the finish of the die, and by the wax used. The finish obtained is usually in the range 60 to 100 micro inches rms. This is about the finish found in preliminary machining or rough grinding. Despite this relatively rough finish, we have had no evidence of excessive losses in our work at the National Research Council. This is probably because of the very short lengths used. It is estimated that the loss is less than 0.1 db per foot at 9 Gc. While precise measurements have not been made, we have not been able to discover any additional losses in components made this way rather than by conventional methods. Of course, this finish is not suitable where high current densities are found, such as in resonant cavities, and in devices having high standing wave ratios or very long lengths, as the losses would no longer be negligible.

For internal surface protection Iridite 14, a commercial dip protective coating, is satisfactory when applied as instructed by the manufacturer. This dip provides a corrosion resistant surface, which remains electrically conductive. This property is useful for joints where conductivity is required. As the base material of the casting is aluminum, the usual steps are required to prevent electrolytic corrosion between dissimilar metals, where the alloy comes in contact with other metals. The use of stainless steel bolts and inserts is usually sufficient. For military use more protection will be required.

Some practical suggestions on investment casting

Where possible, make the thickness of the finished piece as uniform as possible to avoid uneven shrinking of the wax model with consequent distortion of the finished piece. Section thickness should be greater than 0.040 in. in most cases and less than about ⅜ in.

Avoid re-entrant structures whenever possible. A re-entrant design will usually require a multipiece die. On the other hand, it is possible to make re-entrant structures that are difficult, if not impossible by other methods. It will often be necessary to have the die modified after mechanical and electrical inspection of the first samples. This should be regarded as a routine procedure, if the best results are to be achieved.

When considering investment casting for the production of waveguide components, the best results will be achieved by designing initially for this method. A design for other methods of production will not make the most economical or best design for investment casting. Discuss the problem with a foundry engineer early in the development. His experience with the process can help to get the most precise casting at the lowest cost. This may require compromises, to avoid the shortcomings of the process, and to exploit its most useful properties. Also, all foundries do not use exactly the same methods and do not work to the same limits. Other points which may affect the design are the position of the gates, and the parting lines. Early discussion of these and similar points will help to arrive at a satisfactory engineering compromise, and so at the best design.

Castings have been made for the National Research Council in considerable number and variety during the past few years. The cost of the die has varied from $50 to $500 depending on size and complexity, and the finished pieces have cost from 1/20th to 1/10th of the die cost, again depending upon the number of pieces, their size and complexity, and the required tolerance.

To sum up, precision casting is a method well suited within its limits to the making of waveguide components in both large and small quantities, because of the low cost, relative precision and design versatility. END

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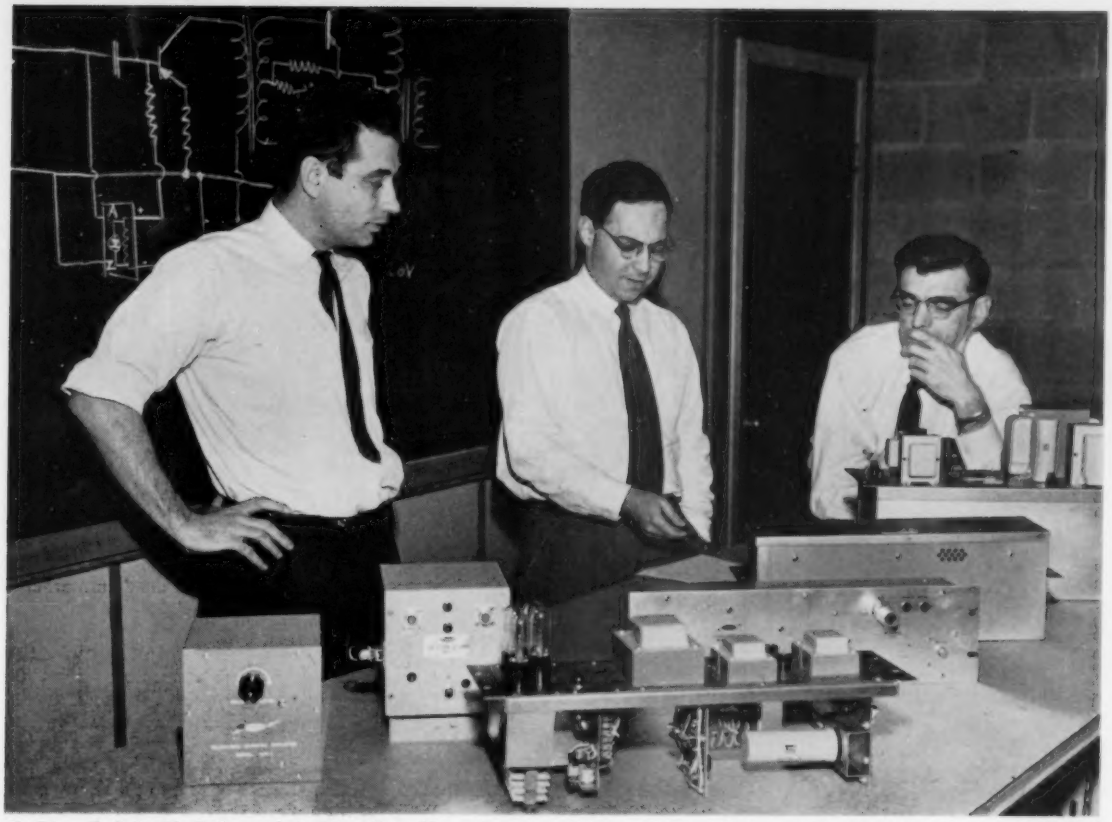


E. Pinnell, left, H. Laks and S. Pinnell tackle a design problem at Pylon Electronic Development Company Limited.

Company profile

Pylon Electronic Development Co. Ltd.

GORDON DUFFY, MONTREAL EDITOR

A compact and imaginative group working in the Montreal suburb of Ville LaSalle — Pylon Electronic Development Co. Ltd. — is making steady progress along the hazardous road of electronics development despite a growing tendency to narrow its scope to the active but low volume field of communications components.

When the team went into business for themselves five years ago they had little more than the combination of their creative minds and high hopes. This year they can look back on 1959 sales amounting to three times the volume of the previous year, and look ahead to what promises to be another large increase in 1960.

Basic reason for this growing stability is a persistence in the field of development that has led to such products as their transistorized 20 cps ringing tone generator with 48v input, the first in the industry; a dc-ac converter for emergency ac supply; 24v and 48v dc-ac static power converters; standard and precision coaxial attenuators; loop test sets and scores of custom components.

As an example, their 206 power assembly features high efficiency because of its conservative design and the fact it is fully transistorized. It operates from 48v battery input and provides signal battery, talk battery, plate battery, machine ringing tone and signalling tone outputs, with full automatic standby.

The idea for the firm had its beginning when Stan Pinnell, the president, helped with the chores on his father's wheat farm in Manitoba. During his years at university (Manitoba, Minnesota, M.I.T.) Stan said he confirmed his belief that he could never work for someone else too long and made further preparations to one-day strike out on his own.

"My early life on the farm had developed a certain independence I couldn't seem to shake, or want to for that matter," he recalled. "Too, so many years of practical farm problems left me with the legacy of never having had any real conception of what research is all about."

Despite his own philosophy, however, he was hired by

the research division of RCA Victor Co. Ltd. and when he left seven years later he was research chief for RCA in Canada. Two others joined him in the venture. One was Herbert Laks, another member of RCA's research team, and the other was his brother Ed Pinnell, who worked in the transistor process pilot plant RCA had at that time.

Although the trio wanted to get into development work as soon as possible, they realized they must first have funds to finance the necessary research. They figured consulting fees would go a long way toward this end and so set themselves up primarily as consultants in the communications field.

"The scheme showed zero results," said the elder Pinnell. "But it taught us that business means dealing with people and that people, unlike engineering physics, are not logical."

In a swift about face the firm became an electronics job shop that took in whatever work came along. During this interval they got a chance to solve some small communications problems, but it was two years before they thought the business on a solid enough footing to get into development work with both feet.

It was a small start at first. Because the firm was small and new it was faced with the prospect any new company faces in having to find out what was needed, then develop it — and, finally, sell it. A sobering statistic was the fact that a survey in the U. S. had established that of the new electronics products developed in that country only about 19 percent paid their own way.

Development work led to new products

In 1957 the firm used the spare moments between jobs to begin development work on a transistorized ringing tone generator with 24v dc input and 20 cycle ac output at approximately 90v. They made a variety of these, and then went on to develop a ringing tone generator for use off 48v input.

At the same time they also began developing circuitry for dc to dc converters and large power amplifiers. By early 1958 work on dc to dc and dc to ac converters was well advanced and prototypes had been under test for many weeks. A number of these units — ringing tone generators and dc to dc power supplies — had been installed by mid-June. Favorable reliability reports enabled them to go into full production with these units by the fall of 1958.

This was a start. While the job work continued they also began, in 1958, to develop a series of standard and precision coaxial attenuators. By January, 1959, these were in full production, and last November a wider selection was offered.

Some of the new developments stemmed from specific custom jobs. An example is the line of transit cases Pylon designed for a firm that was faced with the job of transporting delicate electronic equipment in the north by dog-sled. The firm asked for a container that would protect the equipment from shock, dust and moisture.

Pylon came up with an aluminum alloy case lined with polyurethane that satisfied these requirements. A few other customers also purchased a small quantity of these cases, but the real run on production didn't start until a truckload of electronic equipment was involved in an accident.

When the wreckage was examined it was found that the equipment in the new transit cases was the only equipment that was not damaged in some way. News of the finding trickled through the industry and for months Pylon's production facilities were stretched to the limit to satisfy the demand.

Since they were developed the firm has turned out custom cases for more than 100 electronic instruments. The CBC, for instance, ordered a complete set to protect their mobile TV and radio equipment.

As time went on the firm found itself getting more and more into communications components, rather than electronics equipment generally. One reason, they agree, is that the field is comparatively open. A tremendous amount of money is being spent in the communications industry and, while it is true that a lot goes for copper wire, a lot also goes for newer and better electronic equipment.

"What's more these communications companies have proven to be extremely reliable and have taken pains to be fair with small suppliers like us. We have also found a willingness on their part to do a bit of pioneering — and when they do it's usually with a strong Canadian slant," said Mr. Pinnell.

Quality and service ensure sales

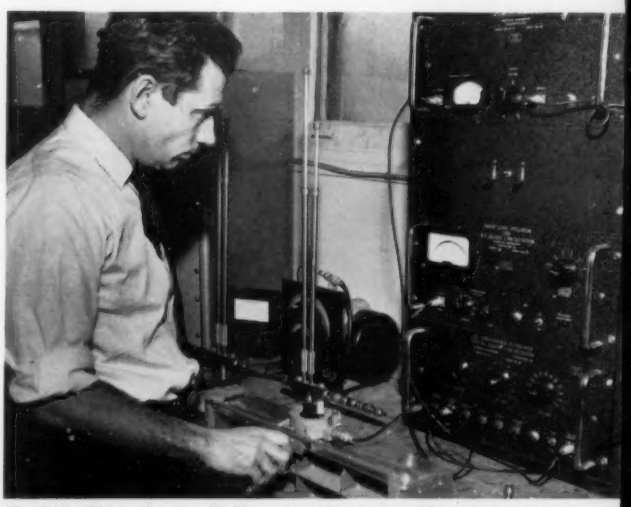
In order to strengthen their position in this field, Pylon gives a flat workmanship and materials guarantee on their products for one year. They feel that this policy, coupled with the assurances of long term service, more than equals any cost differential posed by foreign firms in fields like telephony.

"Actually we could open our import doors wide in this field and not be hurt too much because the users of this equipment want components that will not only last for from 5 to 30 years, but for which they can also be assured of service over this period," he said. "The Canadian market is all we have and we must give good service if we are to survive."

So far Pylon has had only one spot of trouble with this policy. They had to spend $450 to service a faulty $700 piece of equipment. With this object lesson in mind, quality control has become a living word in their production and test shops.

Because the components already developed are still in demand and the production work is going at a steady pace, the engineers are getting more time in recent months for development work. The staff increased from 7 to 13 in the past year and may double again this year if demand continues at the same pace.

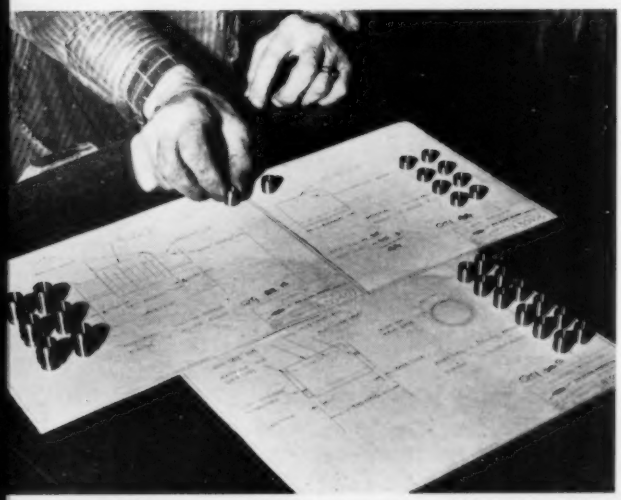
"During the past couple of years we have started getting orders even before we've developed the hardware," said Mr. Pinnell. "If this continues we'll have the combination we've been working for these five years." END



E. Pinnell testing a Pylon precision potentiometer.

Part of the assembly area for ringing tone generators.

Designer Ball working on a custom engineering project.



Parts being assembled for attenuators designed at Pylon.

Wiring harness is prepared for telephone power supplies.

Shop foreman Weininger testing ringing tone generators.

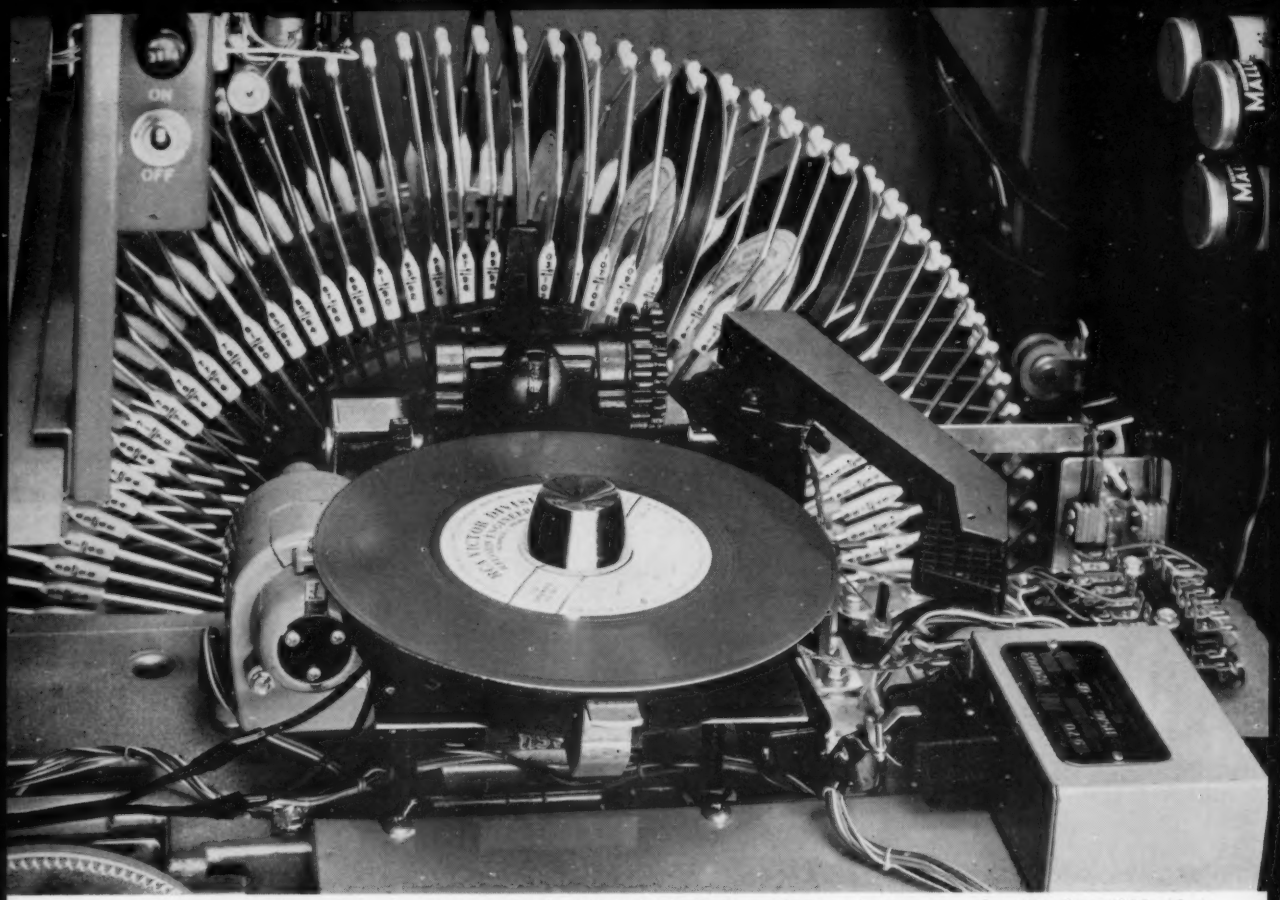


Fig. 1. Pregrooved magnetic discs being used in BQ-104 playback mechanism. System can play 100 discs (200 sides) in random select of fixed sequential mode. Discs are same size as 45 rpm records but they revolve at 33 1/3 rpm.

Magnetic disc system permits automatic programming of broadcast stations

C. S. BROAD*

New modular equipment provides broadcast stations with facilities for automated programming. Conventional records can be used, but the equipment has been designed to make full use of magnetic discs.

Automation has proved itself in many areas of major industry. For some time now, RCA Victor Co. Ltd. has felt that there was a need to update programming aids and methods in the broadcast industry. To do this, the company has relied upon automated equipment designed on a building block basis. A broadcaster can buy and use equipment suitable for his present programming requirements, without fear of equipment obsolescence. The same equipment will form the nucleus of a fully integrated, automated system of tomorrow.

Fig. 2 shows a block diagram of the various components used in the RCA Victor system. One of the most important links in the system is the BQ-51A/BA-51A magnetic disc recorder which combines the advantages of magnetic tape with those of phonograph discs. Using pregrooved magnetic discs, the broadcaster's requirements for a quick method of recording and playback of spot announcements, commercials, station identifications, etc., are easily met. The BQ-51A/BA-51A not only provides for improving present station performance but becomes, at a future date, an integral part of an automatic programming

*RCA Victor Company, Ltd., Montreal.

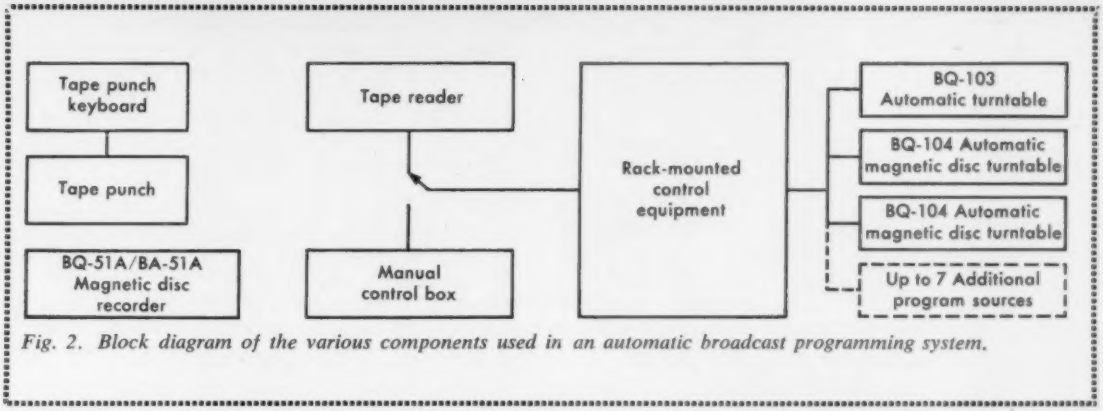


Fig. 2. Block diagram of the various components used in an automatic broadcast programming system.

system, since the pregrooved magnetic discs are readily adaptable to record changing mechanisms that are now enjoying increased popularity in broadcast use (Fig. 1).

The magnetic recording system is extremely simple in operation, minimizing the skill required to produce a professional recording. Grooves for the recordings are molded into the blank discs. Since cutting mechanisms, optical devices and heated stylii are not required, the recording operation is considerably simplified. In addition, the same equipment serves both for recording and for playback.

Magnetic discs have many advantages

The pregrooved magnetic discs have a physical appearance similar to the conventional 7-in. 45 rpm phonograph record. They are extremely rugged, not easily scratched and can be played innumerable times without loss of fidelity or without increased noise. Information can be recorded on both sides and erased for re-use of the discs.

The magnetic discs are molded from a uniform dispersion of iron oxide particles in a synthetic elastomer (rubber type) binder with various plasticizers, lubricants, and other additives mixed in to give the material the desired physical properties. An aluminum plate is imbedded between the two magnetic layers to provide rigidity.

A maximum recording time of 60 seconds is obtained from each side of a disc, plus an additional 10 seconds for "cue-in" and "trip-out" tones. These cue signals are used when automatic operation is employed, with the magnetic discs being stacked in an automatic playback mechanism (Fig. 1). The playback mechanism (BQ-104) utilizes the cue tones to automatically change the stacked magnetic discs placed in the machine.

The frequency response of the magnetic disc is uniform over the 100 to 10,000 cps range. The grooves are maintained to specific dimensions that provide good tracking of the magnetic head and optimum performance with regard to crosstalk. Crosstalk decreases rapidly as the wavelength becomes shorter; therefore, wide-groove spacing and 33½ rpm speed were determined to be the best combination.

The magnetic head consists of two C-shaped laminations made of material that is extremely hard physically, but very soft magnetically. The head assembly is mounted in a mu-metal shield with the pole tip protruding through a narrow slot as shown in Fig. 4. An epoxy resin is used to provide protection against moisture.

A newly designed tone arm is a companion unit for the magnetic head (Fig. 3). It will accept most standard

Fig. 3. BQ-51A/BA-51A system for playing magnetic discs. Extra tone arm and cartridge at back of turntable can be used to play standard LP and 45 rpm records.

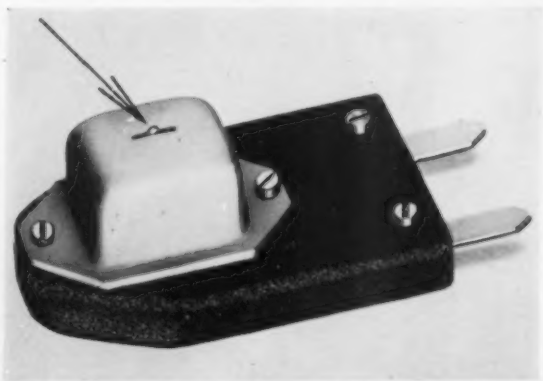


Fig. 4. Magnetic disc recording head uses a stylus but operates in the same manner as a magnetic tape head.

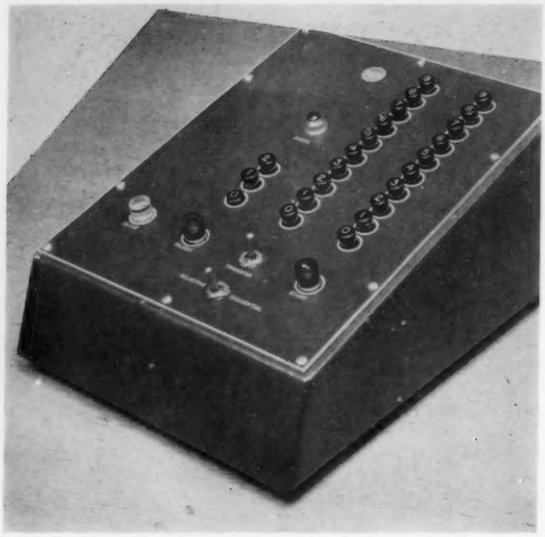


Fig. 5. Random and sequential selection of discs in a BQ-104 can be made on this control. In fully automatic system it is replaced by automatic programming unit.

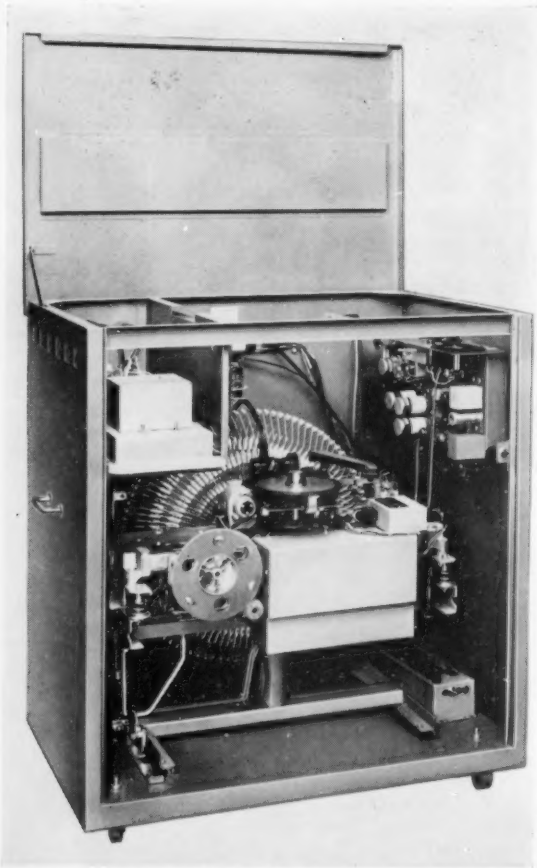


Fig. 6. Curved arm in BQ-104 automatic turntable moves selected disc from basket to turntable for playing.

pickup cartridges with ½ in. mounting centres, permitting the BQ-51A turntable to be used for reproducing standard LP and 45 rpm records up to 12 in. in diameter.

A new amplifier was designed to perform both the recording and playback functions. It has a self-contained power supply and provisions to guard against accidental erasure.

Recordings may be made directly from a microphone plugged into the amplifier, or from a program line connected to bridging input terminals at the rear of the amplifier chassis. The over-all frequency response of the amplifier is equalized from 100 to 10,000 cps.

A push-pull oscillator provides ac bias for low noise recording, and great care has been taken in the design of the amplifier to minimize hum and noise. The input transformer is well shielded and the heater current of the input stage is obtained from a self-contained dc supply.

The BQ-51A is a two-speed turntable that will accommodate 45 and 33 1/3 rpm records up to 12 in. in diameter. The cabinet is designed so that the BA-51A amplifier can be easily installed and the tilted front panel provides operating convenience. The turntable may, of course, be used to play standard records when equipped with an appropriate pickup cartridge and equalizing preamplifier. The turntable is of the rim drive type with a hysteresis synchronous motor.

Automatic turntable permits remote control

To increase the flexibility of the BQ-51A/BA-51A system, RCA Victor has developed an automatic turntable capable of handling 100 discs per loading giving a 200-selection capability. The BQ-104 automatic turntable can play these 200 selections in a random or sequential manner as selected by the operator. This is done by means of a control box remote from the turntable (Fig. 5).

A bulk eraser has been included in the magnetic recording system to provide convenience and speed to the erasure of the material stored on the magnetic discs. (It may also be used for removing recorded material from standard magnetic tapes.) In operation, a magnetic field is produced by an elongated coil that is energized directly from the ac line. The disc (or tape) is inserted through a slot in the top of the eraser case and is held in place by two V-groove rubber rollers so as to be centred in the coil. One of the rollers is driven by a small electric motor which causes the disc to rotate slowly. After two or more revolutions, the disc may be slowly withdrawn from the eraser. The disc is then ready to be re-recorded. Both sides of the disc are erased at the same time.

Magnetic discs provide many advantages

The magnetic disc recording equipment provides the broadcaster with an easy-to-operate means of producing broadcast commercials. The ability to erase and re-use the discs over and over means lower cost, since announcements may be rehearsed until the desired results are obtained. The extremely durable construction of the disc greatly reduces the problem of breakage, providing long recording life. The magnetic disc, therefore, makes it possible to have the advantages of magnetic tape recording in addition to the operating convenience afforded by the conventional recording disc.

This magnetic disc system can be the first of the building blocks purchased by the broadcaster in preparation for a fully automated programming system. It paves the way for companion units, such as automatic turntables for handling conventional 45 rpm recordings (BQ-103 automatic turntable) and BQ-104 automatic turntable for handling magnetic discs. As well, the addition of a magnetic disc recording system not only prepares for the future but it also improves present-day operation. END

Ernest Weber, left, president of IRE during 1959, turns over gavel to Ronald L. McFarlan, president of IRE for 1960.

Canadians show little interest in IRE International Convention

One impression stands out very clearly after three days at the IRE International Convention—very few Canadians attended.

A few Canadian manufacturers braved the problems of New York's Coliseum to present their products and services to prospective U. S. customers. Canadian representatives were out in fair numbers working on booths, attending sales meeting held coincident with the convention, and scouting around for new principals.

But Canadian engineers were almost conspicuous by their absence.

Perhaps it was just as well, considering the frenzied activities of the placement consultants and other hiring agencies. But one begins to wonder about the over-all significance of this trend. Can Canadian engineers not afford to attend; are they too busy to attend; are the technical papers too far removed from the work being done by Canadians; is sufficient engineering information available from other sources?

Whatever the reason, the name "International Convention" held little significance for Canadians this year.

Space: problem and highlight

Space took on a double meaning at this year's convention. Every corner and backwash of the New York Coliseum had a display tucked into it, and the overflow spilled out into hotels for blocks around. And trying to compete with some 60,000 other people for a few square inches of aisle space for your feet demanded a strong constitution.

Scientists from Space Technology Laboratories, Inc. had the problem licked. A few days before the IRE convention opened they sent their Pioneer V satellite just about as far away from the Coliseum as possible. From a position in space nearly 1.5 million miles from earth, Pioneer V took part in the official ceremonies opening the 1960 IRE International Convention. In fact, from its remote position it dominated the convention. The launching had been

IRE International Convention kept Canadian delegates busy

almost perfect and it was obvious that the Americans were very pleased and proud—as they had every right to be.

Space technology, with all its ramifications, may have been one of the themes of the exhibits. It would be more accurate, however, to say that the exhibits reflected general industry-wide progress with a few isolated, and unrelated, outstanding achievements.

Semiconductors open new development possibilities

American components manufacturers, urged and driven by military and space people, have been making progress in the areas of reliability and miniaturization. It is not surprising to find the two problems merging as the state of the art advances.

Radically new techniques in component and circuit production are beginning to appear as semiconductors are assembled, and even grown, into complete electronic circuits. Companies, such as Texas Instruments Inc. displayed circuits made from a piece of high purity semiconductor material no larger than the head of a match.

Working way out in left field was International Rectifier Corp. with their solar powered electric car. They have fitted a panel of silicon solar cells on a 1912 Baker Electric automobile . . . and it works.

Almost all the transistor manufacturers offered Esaki tunnel diodes in germanium, silicon or gallium arsenide versions. Some claimed to be in actual production, while others were producing on a pilot-run basis.

Litton industries drew a steady stream of engineers with their Printapix and sent each one home with a picture of himself. Using a closed circuit tv system, the image is fed to a cathode ray tube designed for direct electronic printing on non-sensitized dielectric material. The charged pattern on the dielectric paper is then dusted with a pigmented powder and permanently fixed by heating for a short time.

Instruments show automation influence

Many of the instruments displayed showed some effect of automation in their design. Analog-to-digital converters and readouts were quite prevalent, leading to automatic recording and analysis of results.

Allen B. Du Mont Laboratories showed how their digital readout oscilloscope could be used with a keypunch so that readings from the scope are automatically transferred for permanent record and processing.

Claimed to be the world's fastest oscilloscope, the Edgerton, Germeshausen & Grier models 707 and 708 can detect and display phenomena lasting only 20 billionths of a second. They are travelling wave deflection type oscilloscopes.

Canadians display quality products

The few Canadian manufacturers exhibiting at the IRE International Convention concentrated on products that could be classified as high quality, medium or low volume. These companies included The Constanta Co. of Canada Ltd., E.M.I.-Cossor Electronics Ltd., Sinclair Radio Labs. Ltd., and The Consolidated Mining & Smelting Co. of Canada Ltd.

In addition, some Canadian products were displayed in other booths. Tinsley Instruments (Canada) Ltd. had just completed an agreement with Sensitive Research Instrument Corp. making SRI exclusive representative of Tinsley in the United States. J. Sutcliffe, general manager of Tinsley Instruments (Canada) Ltd. gave an enthusiastic report on their activities at the show.

"This is our first major assault on the U. S. market and if the response is any indication of the outcome, we shall have difficulty in meeting the demand. We are exhibiting our usual range of instruments and two new ones. The new items are attracting most interest. The first is a six figure dc potentiometer with accuracy between 10 and 100 times better than anything presently available from U. S. sources. The other is a thermometer bridge reading from —50 C to +711 C in increments of 0.001 deg. C. This instrument, a development of National Research Council, reads directly in degrees and does not require the usual conversion from ohms to degrees."

The Raytheon booth featured two products from the Canadian plant at Waterloo. One was the radar-to-tv scan converter, winner of the product design award at the IRE Canadian Convention last year. The other was a radar target simulator used to train air traffic controllers.

Canadian engineers deliver two papers

A. H. Secord and W. V. Tilston of Sinclair Radio Labs. Ltd. presented a paper on a new colinear antenna array. It described the application of a special phase changer which, when periodically distributed along a cylindrical conductor, controls the phase of the radiating currents and so concentrates the radiation in a plane, perpendicular to the axis of the cylindrical conductor.

The other Canadian paper given by B. Tennent of Philips Electronics Industries Ltd. described a multiplex voice frequency carrier system with increased teletype and signalling facilities. Recent developments of high permeability ferrite core materials and low loss plastic film

This truly portable tv receiver drew many visitors into the Sony booth. Set works off batteries and has 7 in. tube.

capacitors has permitted the design of tone resonators with a much higher storage factor.

All available technical papers will be published in ten different convention records. They will be available in July of this year, and complete information about costs and ordering may be obtained from The Institute of Radio Engineers, Inc., 1 East 79 St., New York 21, N.Y. END

The Montreal Section of IRE will entertain R. L. McFarlan, president of the Institute of Radio Engineers, on June 8. Dr. McFarlan will address the members at an evening meeting in Ecole Polytechnique, 2500 Guyard Street.

John Knowles of Instronics was surrounded when this picture was taken. He had a busy time catching up on new developments and holding meetings with principals.

John Sutcliffe of Tinsley Instruments (Canada) Ltd., centre, met keen interest for his products in the S.R.I. booth.

At the Jerrold Electronics Corp. booth Flt. Lt. A. M. Anderson, Rockcliffe sought news from A. E. Dworkin.

Mr. H. Flynn, DRB, left, and Dr. D. W. R. McKinley, NRC, visited P. Yachimec at Sinclair Radio Labs. booth.

What's new in view

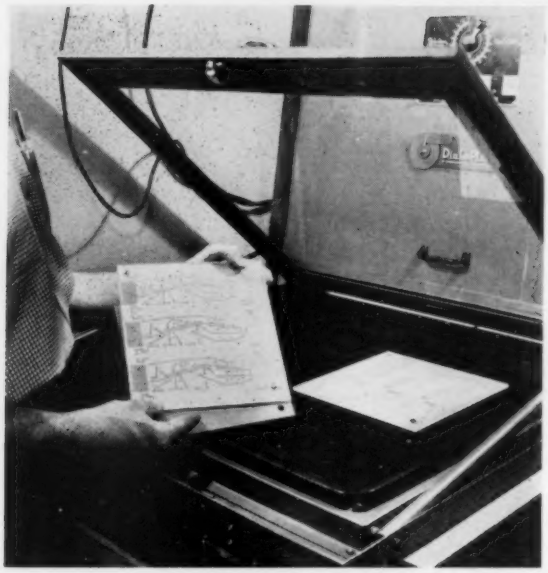
Electronic aids train air traffic controllers

Department of Transport's school for air traffic controllers in Ottawa makes use of an ICAO-developed synthetic traffic control trainer. One group of students acts as pilots while other group acts as controllers.

Experimental machine built at Bell Telephone Laboratories can read limited range of handwritten cursive script. Writer moves metal stylus over a special surface as if he were writing with a pencil.

Another product of Bell Telephone Laboratories, this aluminum oxide used as a potting agent in powdered form possesses several advantages over other potting compounds.

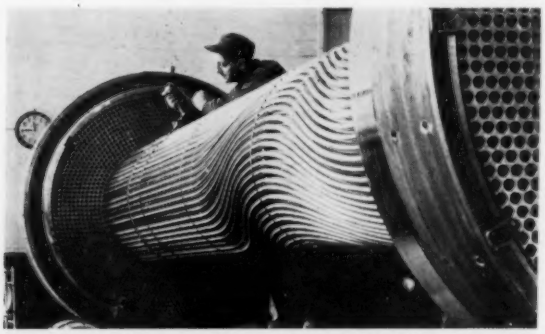
Microwave antenna pattern range built entirely indoors by Budd-Stanley Co. measures antenna with gains up to 30 db in azimuth and elevation planes. The range is an 11-foot octagon in cross section and about 40 feet in length.



Paper negative templates are used to transfer circuitry patterns to boards at Librascope Inc. Template is formed by bonding translucent paper stock to rigid plastic.

High speed printer plotter made by Briggs Associates, Inc. can plot out graphical or printed data at 300,000 points a minute from counter-processed magnetic tape.

New ceramic cathode support (left) for tv picture tubes developed by Sylvania Electric Products Inc. reduces warm-up time. At right is complete cathode assembly.



Sine curve tubing is shown being installed in the Alco heat exchanger for the Enrico Fermi Atomic Power Plant. The stainless steel tubing was supplied by Allegheny Ludlum Steel Corp. to Alco Products, Inc., who put the sine curves in the 18-foot stainless steel tubes.

The Scientific and Process Instrument Div. of Beckman Instrument, Inc., has developed and built a mobile air sampling unit for the Orange County, California, Air Pollution Control District. It is equipped to make continuous quantitative analysis of contaminants in air.

Canadian display at 1960 Nuclear Congress promotes exports

The Canadian Department of Trade and Commerce took an active part in promoting Canadian products and services at the Sixth International Atomic Exposition, New York Coliseum, April 3-8. They presented an integrated display in co-operation with 18 Canadian companies.

The visual effect of this complete "island" was rivaled only by a similar display presented by the French exhibitors. These two stood out above all other displays and attracted many interested visitors.

First reactions from the Canadian manufacturers helping to staff the exhibit were enthusiastic. Several good leads were received during the show and the prospect of export sales looked quite good for some of them.

Of course, several of the Canadian exhibitors are already selling their goods and services to U. S. and European customers. But Canada needs greater export sales and the Department of Trade and Commerce is assisting in many ways such as this. The display at the atomic exposition was under the supervision of R. A. Frigon, Chief, Engineering and Equipment Division, Foreign Trade Service, Department of Trade and Commerce. Credit is due him and his staff for the fine job they did.

Canadian companies stress specialized skills

The companies in the integrated Canadian display offered a wide variety of products and services for peaceful uses of atomic energy. Included were power reactors and reactor components, fuel elements, radioactive isotopes, scintillometers, irradiation equipment, uranium and uranium oxides, measuring and control equipment, consulting and research services.

This is a brief description of what the companies offered.

A. M. F. Atomics (Canada) Ltd., Port Hope, Ont. exhibited models of natural uranium fuel elements for use in research and power reactors. These included extrusion bonded aluminum-clad plates of metallic uranium, aluminum-clad unbonded bars of metallic uranium, and unbonded rods of high density uranium dioxide clad with zircaloy or aluminum alloys.

Atomic Energy of Canada Ltd., Commercial Products Div., Ottawa, featured their Gammacell 220 which provides high gamma fields for research irradiations. Fourteen of these irradiators, valued at over $200,000 are in use in North America and Europe. In addition, almost $3,000,000 worth of Cobalt-60 has been shipped from Chalk River.

B. D. Bohna & Co. Ltd., Vancouver offered nuclear facilities, design and construction. This company carried out the design and supervision of construction of a high level radiochemistry facility for the U. S. Atomic Energy Commission at Hanford, Washington. They pioneered a pneumatic method of placement of high density concrete for radiation shielding.

Canadian Engineering (International) Co. Ltd., Montreal, a firm of consulting engineers, has developed a new shaft excavator suitable for preparing sites for nuclear waste disposal. They claim they can reduce costs by as much as 50%.

Canadian General Electric Co. Ltd., Peterborough, Ont. had four major parts in their display: nuclear power in Canada; nuclear power demonstration project (NPD-2), for which C.G.E. is prime contractor; a working model of an organic-cooled deuterium reactor (OCDR); and nuclear fuel manufacturing facilities at Canadian General Electric Co. Ltd.

Canadian Westinghouse Co. Ltd., Hamilton, has done extensive work in the design and production of in-reactor and out-of-reactor test loops. This formed part of their display.

Consolidated Denison Mines Ltd. is the largest single producer of uranium in the free world and they were looking for prospective buyers at the exposition.

Eldorado Mining & Refining Ltd., Port Hope, Ont. showed a variety of refined uranium prodctus.

Instruments dominated the 1960 exposition

Electronic Associates Ltd., Toronto had one of the highlights of the exposition. Their model train, equipped with a radioactive isotope identification and control system, consistently drew large crowds. Officials from some of the railways in the United States have expressed interest in this system which could save time and money in keeping track of rolling stock, and operating switch blocks. Heart of the system is a code pattern of radioactive buttons under each train car. Detectors at strategic points can feed information into a central processing station.

The train display was so attractive that someone stole the trains during the show. Officials were quite concerned until convinced that the radioactivity of the code buttons was no stronger than many luminous watch dials. The trains were later found abandoned in the Coliseum.

Another development of Electronic Associates that attracted interest was the K & H ore sorter. This is an automatic means of grading uranium ore as it falls from the end of a conveyor belt. The device inspects chunks of ore as they are falling through the air, measures their radioactivity and size, calculates the grade and, providing it is below a certain preset standard, causes an air blast to deflect the piece to the waste bin. The measuring equipment was developed by Electronic Associates while the air blast valve and other equipment was designed by two engineers at Bicroft Uranium Mines. (CEE will publish a feature story on this equipment in a future issue).

Electronic Associates have been successful with export sales on some of their other products. One of their geiger tubes is being used by Tracerlab, Inc. in an area monitor.

Gunnar Mines Ltd. displayed uranium oxide and refined uranium products.

Merck & Co. Ltd., Montreal synthesize compounds of both stable and radioactive isotopes for research purposes. Many of these were on display.

Nuclear Enterprises Ltd., Winnipeg showed a new transistorized scintillation counter and three new plastic scintillators. The latter include an alpha particle detector, a hollow plastic scintillator for beta ray spectroscopy, and a gamma flow detector.

Ontario Research Foundation, Toronto, is a non-profit research and design organization. They displayed items in the fields of radioactive waste disposal, electron physics and air pollution which were developed at the Foundation.

Orenda Engines Ltd., Toronto, stressed the capabilities of their specialists in the field of nuclear physics, nuclear engineering and nuclear materials.

RCA Victor Company Ltd., Montreal, created quite a stir in the industry with their new silicon junction alpha detector (CEE, April 1960, page 26). At the present time they lead the field in this type of work.

Sarnia Inspection Co., Sarnia, Ont. offered inspection services using radioactive sources. They featured a patented system which enables accurate location of defects in castings, welds, etc.

Sorel Industries (1959) Ltd., Montreal, have accumulated considerable experience in fabricating atomic reactor components. They showed photographs of some of their products and facilities.

Velan Engineering Ltd., Ville St. Laurent, Que., exhibited some of their high-pressure, high-temperature, forge bonnerless valves for nuclear applications.

The Canadian products face stiff competition in world markets, but the quality is high. The major barrier appears to be one of "selling and promoting". With the help of people such as the Department of Trade and Commerce, Canadian manufacturers should be able to acquaint foreign buyers with their products, but the main work in selling still rests with the manufacturers. END

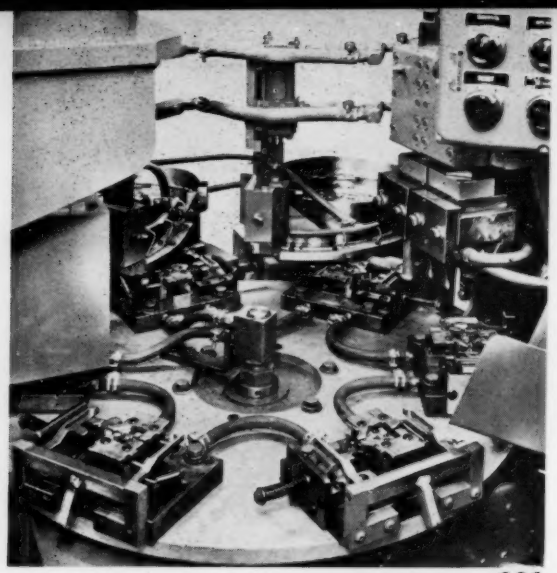
Dr. Whitehead, left, and P. Webb, right, of RCA Victor Research Labs. demonstrate solid state alpha detector.

Model train demonstrating Electronic Associates isotope control and identification system drew many visitors.

Mr. G. I. Staber, left, A.M.F. Atomics (Canada) Ltd., shows equipment to His Excellency, Hervé Alphand, French Ambassador to the United States. With him is R. A. Frigon of the Department of Trade and Commerce.

New products

For further information on New Product items, use the Reader Service cards on pages 65 and 66

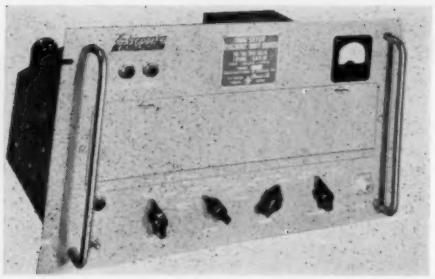


101

Dual head, dial feed welding machines 101

The new line of precision dual head AVB-3 dial feed welding machines is designed for mass production welding of small parts such as electrical components. The photograph shows a six-station Geneva dial feed machine tooled for welding spring contacts to two different styles of yokes for electrical outlets, one of which requires a forming operation. Parts are fed and ejected automatically at a rate of 1500 to 1700 parts per hour. The machines can be equipped with tooling to form, assemble and fasten a variety of parts. Standard models are available from 10 to 50 kva.

Precision Welder & Flexopress (Canada) Ltd., Toronto.



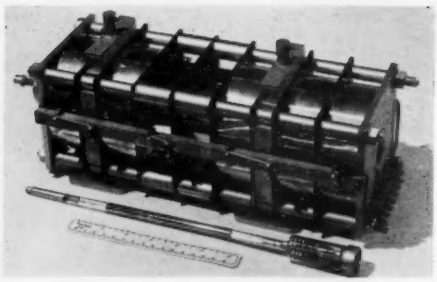
102

Multiplexing frequency shift exciter 102

A new crystal-controlled low frequency radio-teletype exciter, developed and manufactured in Canada, combines two teletype line signals and provides a radio frequency output which shifts between four different frequencies. Frequency separation of model DFS 21 may be adjusted from ± 5 cps to ± 90 cps. As a result of high inherent stability of the crystal-controlled frequencies, it is possible to employ very narrow shift separation, and obtain more efficient spectrum utilization. For example, with this equipment adjusted to 31.7 cps separation, two radio teletype channels may be operated in the same bandwidth previously occupied by a single NATO $\pm 47\frac{1}{2}$ cycle channel.

The final output frequency is determined by a single crystal which may be replaced without affecting shift circuit adjustments to provide any output frequency from 75 to 375 Kc. The unit is self-contained, suitable for rack mounting, and provides variable power output to two watts into 52 or 75 ohms having spurious or harmonic content below 40 db.

F. V. Topping Electronics Ltd., Toronto.

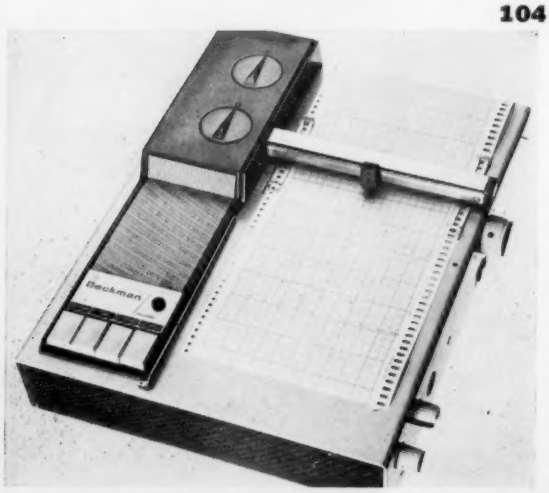


103

Traveling wave tubes 103

Type W10/3E (illustrated) is an S-band, low noise traveling wave tube designed specifically for use as the rf input stage in radar receivers. It operates with a typical tube noise figure of 6.5 db at a gain of 23 db.

104



Type W5/1G is a power tube for use in the 5.8 to 7.2 Gc (gigacycle or KMc) band, delivering a maximum of 20 watts to the antenna and having a gain of 38 db at 10 watts output.

Type W9/1E, for use in the S-band, has a noise factor of only 18 db, a gain of 35 db and a maximum power output of 120 milliwatts. Operating range is 2.5 to 4.1 Gc with a vswr less than 2 without tuning.

Standard Telephones & Cables Mfg. Co. (Canada) Ltd., Montreal.

Strip chart recorder 104

The Scientific and Process Instruments Division of Beckman Instruments, Inc. has introduced a low-cost, portable potentiometer strip chart recorder for laboratory use. It features push-button operation and a nylon tape pen drive which assures positive connection between pen and slide wire, and permits the use of over-size strip charts or of circular charts. The recorder, which operates on 105-125 volts, 50/60 cps, monitors dc signals in the 10-100 mv range and provides 5 in. pen travel and repeatability of better than 0.35%. Pen response is 1.0 second, full scale.

Beckman Instruments, Inc., Toronto; Van Waters & Rogers Co. Ltd., Vancouver.

Thermoelectric modules 105

The use of a new bismuth telluride alloy in the production of thermoelectric modules now makes thermoelectricity an efficient and economical means of cooling volumes up to 4 cubic feet. The BiTe crystals, which are formed from a liquid state are approximately 60% as efficient as a mechanical compressor for cooling purposes. The p-type alloys have a figure of merit of 4 to 4.5 x 10^{-3}, and the n-type 2.7 to 3 x 10^{-3}. At 100 deg. C this gives the modules a temperature difference of 105 deg.

The modules consist of p-n couples in series with copper electrodes and leads projecting to and from a matrix. The thickness of matrices can be varied for use under different heat loads.

Materials Electronic Products Corp., Trenton, N.J.

Low cost vtvm 106

Designed for servicing of tv, fm and hi-fi amplifiers, the model VMK-2 vacuum tube volt meter has a 6 in. multicolored scale for easy interpretation. It can be used for measuring dc volts, rms or peak-to-peak ac volts in 7 ranges; also resistance up to 1000 megohms. It is available in kit form and the printed circuits, pictorial diagrams and step-by-step instructions make it easy to assemble.

Stark Electronic Sales Co., Ajax, Ont.

High channel TV transmitter 107

Suitable for the transmission of either monochrome or color television signals, transmitter model TTC-99-B can be operated from 12.5 Kw sync. peak through to 25 Kw sync. peak power output. The 25 Kw amplifier portion can also be used to increase power for existing stations.

Other features include: a built-in sweep generator to aid servicing; automatic power failure restart operation, which allows for automatic reapplication of power in case of momentary power supply failure; complete air cooling using external blowers; positive control and protective circuits, including vswr protection; built-in standby features in the driver.

Canadian General Electric Co. Ltd., Toronto.

DC breakdcwn tester 108

Model DV-12V direct current breakdown tester makes available to the operator a metered voltage of from 0 to 12 Kv filtered dc at a current capacity of up to 5 ma. Any of the standard CRI plug-in sensors may be used with this to give a wide variety of sensitivities of fault indication from the microampere region up. Originally designed as a dc spark tester, this test set can be used as a variable dc power supply and adjustable sensitivity breakdown tester. Model DV-12V was designed and is being manufactured in Canada.

Canadian Research Institute, Toronto.

Television tuner 109

The Mark VIII miniature tv tuner is available in tetrode, cascode and neutralized triode versions. They are 13-mechanical/12-electrical position tuners having full 12-channel adjustments available in the oscillator circuits. Wiper contacts receive minimal flexing in operation, thus reducing fatigue and maintaining uniform contact pressure. The Mark VIII triode noise figures are some 2 to 3 db better than the tetrode version, while the tetrode version has some 2 to 3 db better gain over all channels.

General Instrument, F. W. Sickles of Canada Ltd., Waterloo, Ont.

Testing equipment 110

A new line of electronic test equipment, manufactured in Scotland by Allscott Electronics, is being introduced into Canada.

The spectrum analyzer is designed for use at audio and supersonic frequencies. The frequency range of the standard instrument is from 1 Kc to 90 Kc, but custom-built equipment for other frequencies is available.

The noise measuring equipment is designed for use in measuring the magnitude and spectrum of microwaves associated with navigation systems. It incorporates an rf frequency discriminator in the form of a waveguide bridge to overcome the difficulties of crystal burnout, and the necessity of rejecting am of the carrier when studying spurious fm.

Ferranti-Packard Electric Ltd., Toronto.

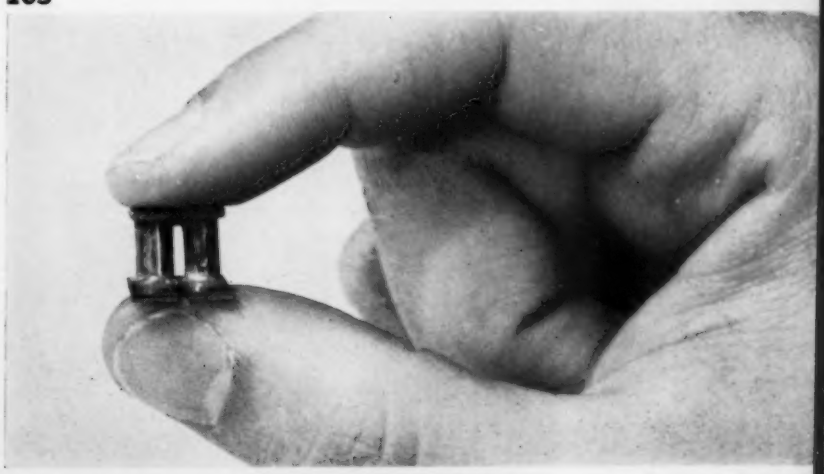
Cold trap 111

The Milton Roy Serfass cold trap maintains temperatures of -50 to -140 F for high vacuum experiments and other intermittent requirements. It is a self-contained refrigerator system, complete with a 700 milliliter thermos flask. Electric motor operated (800 watts from 115 vac), the two-stage compressor uses a non-toxic, non-flammable refrigerant.

Consolidated Engines and Machinery Co. Ltd., New Toronto, Ont.

(Continued on page 49)

105



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For your library

New text stresses the basic physics of semiconductors

Semiconductors

R. A. Smith; (Cambridge University Press) The Macmillan Company of Canada Ltd., Toronto; 494 pp; $11.25.

Reviewed by A. G. McNamara, Radio and Electrical Engineering Division, National Research Council, Ottawa.

This book is primarily a review of the basic physics of semiconductors, written in a logical and interesting style. It opens with a fascinating historical account of the slow fumbling approach to semiconductors from the earliest work of Faraday in 1833, to the accelerating developments of the past few decades beginning with the elementary theories of A. Sommerfield and A. H. Wilson using quantum mechanical theory. Dr. Smith then proceeds with the theory of energy levels in crystalline solids using wave mechanical methods. Some knowledge of quantum mechanics is needed to follow the development, but the treatment is concise and pointed without drawing the reader through all the mathematical steps. These basic results are then progressively extended to examine the effects of impurities and imperfections such as interstial atoms, dislocations, bonds of various types, and the resulting energy level structure.

Subsequent chapters, employing quantum mechanical and thermodynamical principles, investigate the movements of electrons and holes, relaxation times, conductivity, Hall effect, scattering, and thermal effects.

A series of chapters on optical effects, high frequency effects, and methods of determining the properties of semiconductors, give an excellent presentation of the theoretical aspects of experimental measurements of band structure and impurities. The discussion leaves the reader with a real appreciation of the difficulties involved in measuring and interpreting the parameters accurately and correctly.

The book goes on to detail the physical properties and the energy band structure of specific element semiconductors (particularly Ge and Si), and then the compound semiconductors. Brief mention is made of practically all the semiconductors thus far investigated. Considerable detail is given on the optically important compounds InSb, PbS, PbSe, PbTe. A final chapter reviews the fundamental fabrication techniques and applications of semiconductors in relation to the physical theory developed throughout the book.

Dr. Smith's book is an excellent summary of the semiconductor field. Because of the enormous scope of the subject, many aspects are necessarily brief; however, virtually every page is footnoted with many references to the key papers or more complete reviews. The book is written in the style of a textbook for graduate physics. The applications engineer will find it of little practical value, but it will be a valuable reference text for those engaged in fundamental or developmental research on semiconductors.

Publishers' new releases

Transistor manual

The fourth edition of the GE Transistor manual has 227 pages of information on transistors and their use in electronic circuits. It is priced at $1.25 and may be purchased either from the company's distributors or from Canadian General Electric Co. Ltd., 189 Dufferin St., Toronto.

Directory of University Research Bureaus and Institutes

Gale Research Co., 34th Floor, Book Tower, Detroit 26, Michigan; 208 pp; $20.00 (U.S.).

This is a reference guide to university research bureaus, institutes, centres, experiment stations, laboratories, etc., set up on a permanent basis and carrying on a continuing program of research in specialized fields.

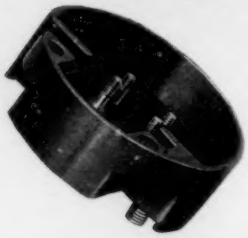
Thermistors and Varistors

Data book provides information on thermistors, varistors, thermal conductivity cells, electronic controls and thermal, electronic and physical-sensing devices. There are 38 pages of engineering information, including a comprehensive bibliography. The book is available for $1 from Victory Engineering Corp., 508 Springfield Road, Union, N.J.

Tung-Sol Tips

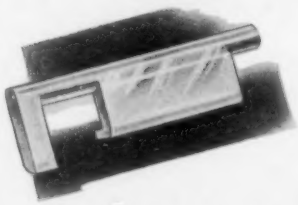
This periodical on industrial electronics serves the areas of application, installation and maintenance. It provides practical information including basic theory, circuit diagrams, and typical applications. Copies may be obtained from Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N.J.

Bach-Simpson now provides Canadian source for special military aircraft instrument

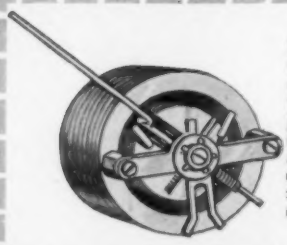


An improved, compact base of thermo-setting plastic for the range switch contacts was engineered, tooled and molded in our own plant.

As an item which had never been produced in Canada, the specialized dual function volt-ammeter presented an opportunity and a challenge to our ingenuity. It posed an interesting problem — that of improving the product through the use of the latest materials and techniques, while maintaining interchangeability with equipment already in service, and employing standard Bach-Simpson components, where possible, in the interests of economy.



A simpler and more compact contact actuating mechanism employing a new thermoplastic material was designed, tooled and molded by Bach-Simpson Ltd.



Weight reduction (by 50%) and reduction of stray field effects on adjacent magnetic compasses were achieved by the use of Bach-Simpson's self-shielded core-magnet movement.

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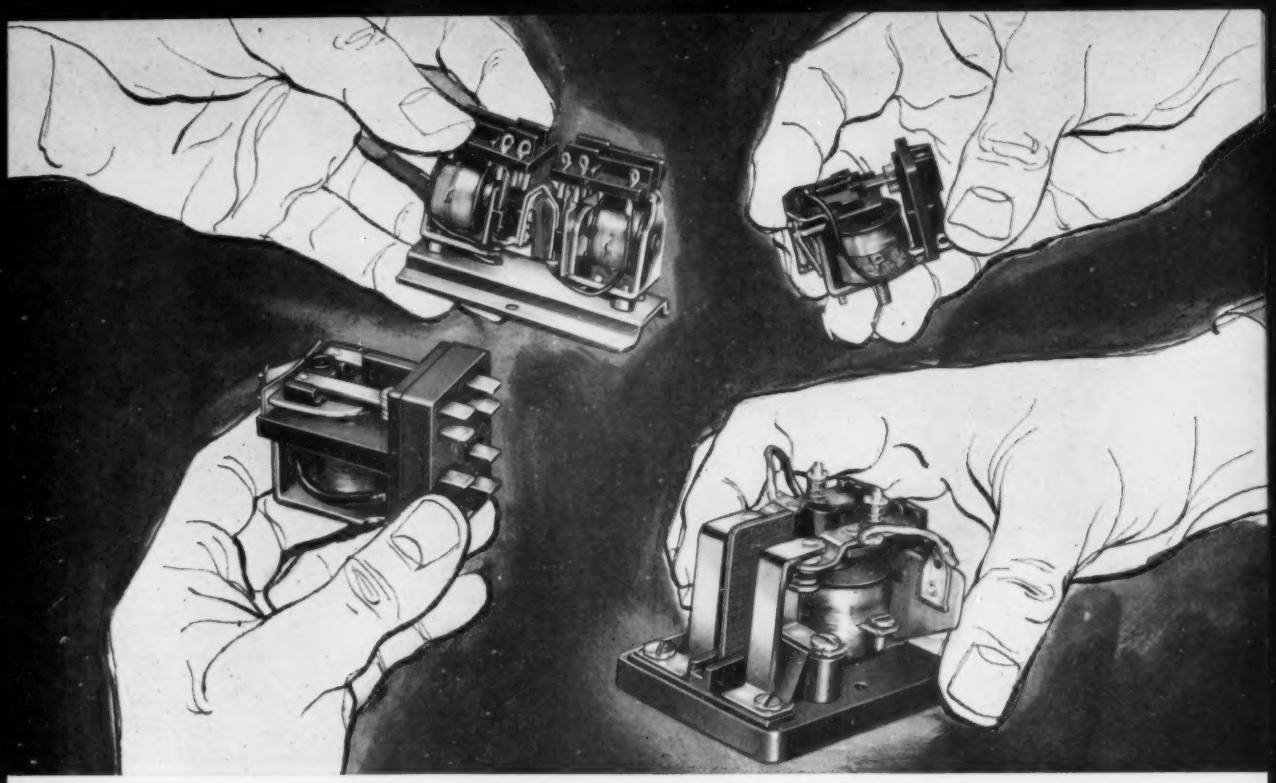

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PR Series

Type	Contact Arrangement*	Type	Contact Arrangement*
PR1AY	SPST-NO	PR5AY	SPDT
PR3AY	SPDT-NO-DM	PR7AY	DPST-NO
		PR11AY	DPDT

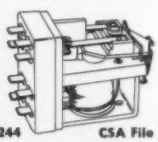
These relays are available in any of the following operating voltages: 6, 12, 24, 115, 230 volts 50/60 cycles AC.

Contacts are rated at: 25 amps, 115/230 V. AC 1 phase. 1 hp for 115/230 volt AC motors 1 phase.

*Read: NO normally open, NC normally closed, DB double break, DM double make.

U/L File E22575 CSA File 13734

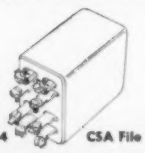
AB Series



U/L File E29244 CSA File 13734

For appliance and general purpose operations requiring long life and quiet operation. Quick connect terminals. Screw terminal adapters also furnished with each relay. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.

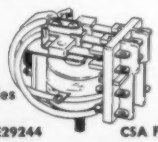
ABC Series



U/L File E29244 CSA File 13734

Medium duty power relay in dust cover. For small motors, industrial controls and similar applications. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.

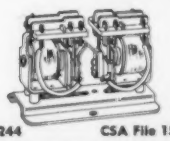
KA Series



U/L File E29244 CSA File 13734

Small, low cost, general purpose relay for handling automation work, small motors, solenoids, other relays. Contact arrangements: SPDT, DPDT and 3PDT. Rated at 5 amps, at 115 V., AC non-inductive by U/L and CSA.

KB Series



U/L File E29244 CSA File 13734

Compact latch relay ideal for memory work and overload applications. Operates on momentary impulse to either coil. Contact arrangements: 4PDT and 6PDT. Rated at 5 amps at 115 V., AC non-inductive by U/L and CSA.

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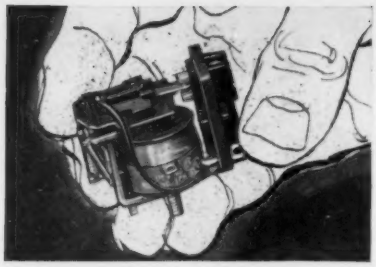

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1315 Victoria Avenue

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Western Radio Supply Co. Ltd.
182 Rebecca Street, (at Ferguson)

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Ottawa report—cont.

$1 million to a Norwegian firm to build heavy tramways when competent firms in Vancouver bid $100,000 to $125,000 below the price which was accepted?"

He said he presumed the design of the Vancouver firms, which he did not name, was acceptable since they received a $20,000 design and engineering fee "to go ahead with, and they were tossed out on their ear."

Mr. Gordon replied heatedly that Mr. Broome was "making statements I am not admitting as facts at all." He then explained that CNT obtained the U. S. government contract "on the basis of an invitation to tender on an installation of a communications system."

"We were entrusted with the job after a period of keen competition with American suppliers and others who had American affiliations."

CNT had then called for tenders for the installation of the system. Invitations had been issued to RCA Victor Company Limited of Montreal, Standard Telephones and Cables Manufacturing Company (Canada) Limited, Northern Electric Company Limited and Canadian Marconi Company. Canadian Marconi was the only company invited that did not submit a bid.

Mr. Gordon said RCA Victor won the contract because it was the lowest bidder.

"They are our prime contractors," he told Mr. Broome, "and they are perfectly entitled to employ any subcontractor they wish, so long as they meet the performance specifications that we have stipulated for the particular job."

He explained further:

"The system will be constructed and owned by The Canadian National Railways and there is a guaranteed revenue from the United States government, over a period of fifteen years, of an amount sufficient to fully amortize the system, cover our operating expenses and, as well, provide a margin of profit."

At another point in the stormy proceedings, Mr. Broome wondered whether Western Electric in Vancouver and Northern Electric in Montreal were invited to bid on contracts for carrier equipment.

"The reason I am asking this," said Mr. Broome, "is because I know of manufacturers on the West Coast who did their damndest to try to bid on equipment in the microwave contract and couldn't do anything."

Mr. Gordon replied that this was a question only RCA Victor could answer. He said CNT officials have been working with Gracey-McCallum people at Dawson Creek and Fort Simpson in preparation for maintenance and proper operation of the facilities when the system is built—they were exercising "a prudent supervision" of this huge contract. But they were not responsible for RCA Victor's choice of subcontractors.

He also suggested that in view of all the trouble Mr. Broome had caused for RCA Victor about this subcontract, he might be endangering the chances of the Canadian contractors on other work still to be tendered for on the project.

"I would think—I do not know of my own knowledge—that they would be a bit fed up whenever they see the name of whoever it is you are talking about coming up again," the CNR president told Mr. Broome, making clear he was not in any way making a threat.

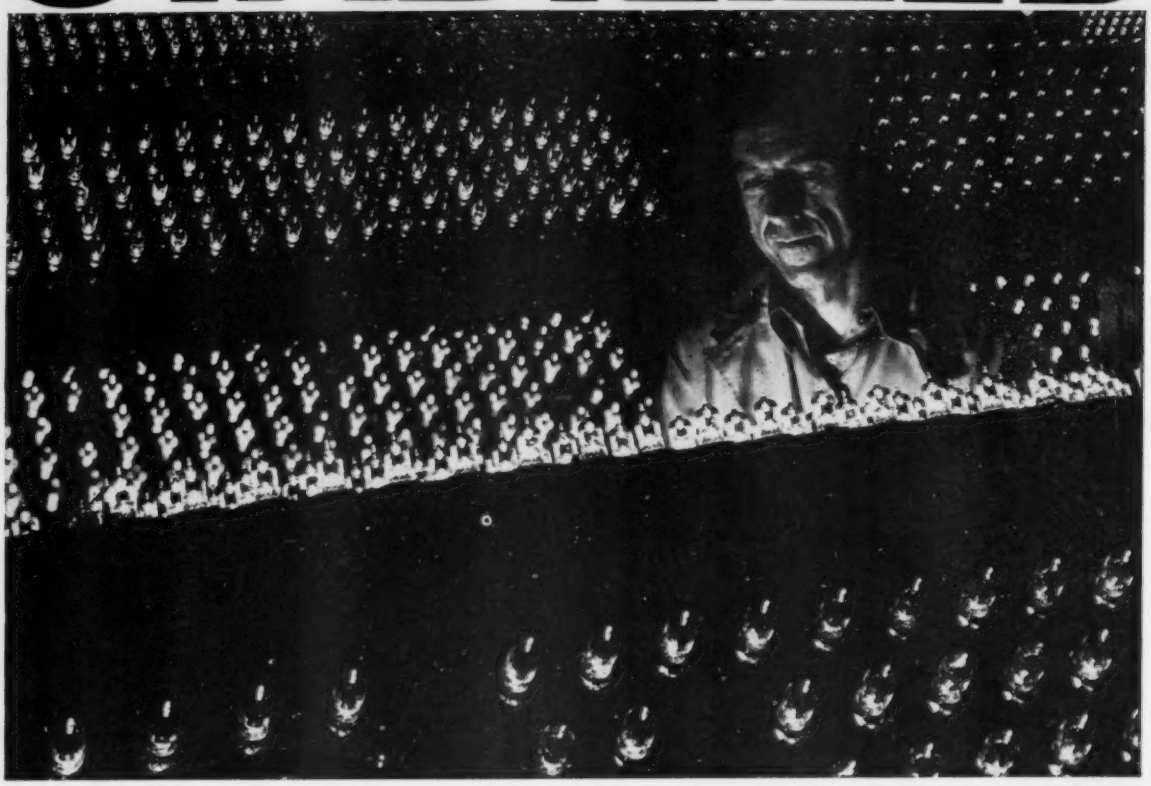
The flow of professional personnel from Canada to the United States was higher last year than in 1958 and virtually the same as in 1957, the peak year recently for the southward migration of professional, technical and kindred workers.

The figures were tabled in the Commons for CCF House Leader Hazen Argue by Trade Minister Churchill. Based on a 12-month period ending June 30, they show that the number of professional, technical and kindred workers moving to the U. S. was 3,634 in 1955; 4,991 in 1956; 5,985 in 1957; 5,749 in 1958 and 5,146 in 1959.

A breakdown of professional people who decided to head south during the last five years shows that a total of 611 went last year, 569 in 1958 and 613 in 1957. Here are the details:

	1956	1957	1958	1959
Engineers, aeronautical.	46	69	35	115
Engineers, chemical ...	41	54	43	30
Engineers, electrical ...	73	159	104	134
Physicists	20	27	30	31
Mathematicians	2	4	4	12
Medical doctors	151	256	218	210
Chemists	112	144	135	79

STABILIZED



Factory Burn-in Increases 5-Star Reliability

ONE FACTOR IN THE HIGH RELIABILITY OF GENERAL ELECTRIC 5-STAR TUBES

All General Electric 5-Star tubes are subjected to a special 48 hour burn-in process to weed out possible early failures and promote more uniform tube performance.

The *stabilized characteristics* of General Electric 5-Star tubes means you can count on them to meet critical requirements at all times.

Stability is only one factor that contributes to the ultra-reliability of General Electric 5-Star tubes. There are many others—the ability to resist shock and vibration—special manufacturing environments—and extremely severe electrical and mechanical tests.

Give your equipment the extra protection of Canadian-made General Electric 5-Star tubes. For full information on industrial and military tubes contact: Electronic Tube Section, Canadian General Electric Co., Ltd., 189 Dufferin St., Toronto, Ontario.

GE Electronic TUBES

TAD-1793-160R

ELECTRONIC TUBE SECTION,
CANADIAN GENERAL ELECTRIC COMPANY LIMITED

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New products — cont.

Multi-range meter tester 112

This multi-range meter tester is suitable for dc instrument calibration from 25 ua full-scale to 10 ma full-scale and 0-100 vdc; sensitivity and resistance measurement; ac current-voltage source; and limit or bridge measurements from 0-5000 ohms. It has a regulated power supply and stepless vacuum voltage control. Its accuracy exceeds ¼% (current) ½ ohm or ½% (resistance).

Honeywell Controls Ltd., Toronto.

Microwave mixer diode 113

Sylvania Electric Products, Inc., has announced a new L-band silicon microwave diode designed for microwave mixer applications. Designated D-4097, it is a point contact type with a maximum conversion loss of only 5.5 db and a maximum output noise ratio as low as 1.5 times.

Sylvania Electric (Canada) Ltd., Montreal.

Group encapsulated resistors 114

Up to 12 sections of Julie Research Laboratories, Inc., precision wire-wound resistors may be encapsulated in one assembly. Individual sections may be isolated or internally series-connected, and individual wattage ratings per section may be either ½ w or 1 w. Resistance range per section is from one ohm to two megohms, and maximum voltage per section is 125 v for ½-watt units or 250 v for 1-watt units.

Precision is ± 0.01% standard, or up to ± 0.003% if required; long-term stability is ± 0.003% per year standard, or ± 0.001% per year if required. Resistors maintain an accuracy of at least ± 0.02% over the temperature range from —30 C to +85 C. Matched pairs of ratios will track to within ± 0.005% over a range from —45 C to +85 C.

Philips Electronics Industries Ltd, Toronto.

Trimming potentiometer 115

Series 50 Helitrim trimming potentiometer uses a ceramic/metal construction (a conducive resistance element fused to a steatite frame) to make it possible to use this small pot in an ambient temperature range of —55 C to +200 C. It is also virtually insensitive to vibration and can ride out 100G's shock. Standard resistance range is 100 to 20,000 ohms with essentially infinite resolution except for 2 ohm maximum end resistance at either end.

R-O-R Associates Ltd, Don Mills, Ont.

Variable capacitance hygrometer 116

The Shaw hygrometer has been designed for application in drying ovens and processes of all types including batch driers. The sensing of moisture is done by a form of variable capacitance so that contamination does not present the difficulties inherent with conductive type elements. The Hygrometer will show one part in a million of water vapor in dry air or gas; it will indicate on a dial or record the humidity of drying ovens; it will indicate the difference in percent relative humidity between dry silica gel and P_2O_5.

Tellurometer Ltd., Ottawa.

Chokeless power supplies 117

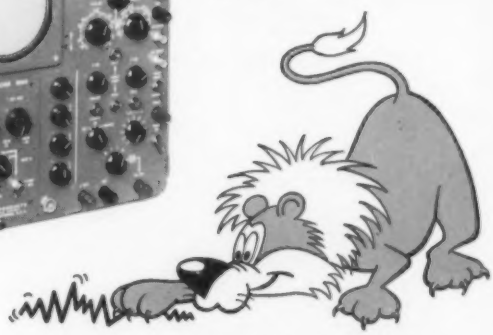
Designed specifically for continuous duty pulse loading applications, the new range of chokeless power supply sub units introduced by the Solartron Electronic Group Ltd., can withstand pulsing from zero to full load without loss of control. Control circuitry maintains a stability factor of better than 400 to 1 and enables the low source impedance to be held up to a frequency of 0.5mc. The range comprises three sub units of 100 ma maximum load capacity (AS 951, 952, 953) and three of 200 ma (AS 955, 956, 957), output voltages covering from 100 to 400 volts. The output voltage of any sub unit can be varied over ±50 volts from normal, also reactive loads may be applied without affecting the specified performance.

Instronics Ltd., Stittsville, Ont.

(Continued on page 56)

New Improved "Memo-Scope"

Hughes "Memo-Scope" Oscilloscope (Model 104E) holds nonrepetitive events for an indefinite period—hours, or days—keeping them available for thorough study until intentionally erased.



Still using "old-fashioned" methods for measuring non-recurring transients? If so, now is the time to investigate the easy way to solve your most difficult transient measurement problems with the latest model Hughes "Memo-Scope" Oscilloscope.

Why? Because new features, new advanced circuitry, new panel layout and new mechanical design now assure maximum accuracy in all your transient measurements — plus higher performance, greater dependability and easier operation!

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Proposed new patent act could stimulate more research in Canada

DON PEACOCK, OTTAWA EDITOR

A royal commission has recommended a completely new Patents Act for Canada which would hinder the greedy exploitation of inventions and reward the inventor most willing to share his discovery with the public.

Under the present Act, where two or more independent inventors produce the same invention, the one who first invents has prior right to a patent.

The commission recommends the principle that the one who first applies have the prior right to a patent. This is the underlying principle of the patent system of all important industrial countries except the United States and Canada.

The commission also recommends that it be mandatory that a patent applicant's complete specifications be thrown open to the public not later than one year after it is filed. At present, it is kept secret until the patent is granted, often many years after initial filing.

There are many other recommendations contained in the 84,000-word report prepared by the three-man commission headed by Chief Justice J. L. Ilsley of Nova Scotia. The report concludes a six-year study on patents, copyright and industrial designs. The commission's report on copyright was tabled in the Commons in June 1958, and on industrial designs in August, 1958.

The patent report was tabled in the House of Commons by Hon. Leon Balcer, acting secretary of state.

The Ilsley Commission report makes clear that one of the main reasons for its recommendation that complete specifications of any patentable invention be published within a year after application is filed, is to encourage swifter use and improvement of new inventions.

This is the purpose behind the proposal an applicant for patent be given the right to file a provisional specification, instead of, as now, a complete specification, and the right to enlarge his disclosure repeatedly until the grant of a patent by applying for patents of addition. A patent of addition would be for modifications or improvements of the original invention.

"The principal advantage of a relatively early publication is that the specifications give information as to the invention to the public promptly, so that the technology can go forward from there instead of starting from that point a considerable period, perhaps years, later," the commission says.

It adds:

"An argument against publication before acceptance is that the applicant may not be given sufficient opportunity to develop and perfect his invention before others forestall him with their own patentable improvements on his invention. We do not find this argument convincing. We think that, on the whole, it is desirable that others should be encouraged to make im-

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provements, even patentable improvements, at an early date.

"The applicant, under our proposals, will have a reasonable opportunity of securing protection upon developments of the invention which he makes himself.

"Moreover, if some other inventor makes some patentable improvements at an early date, the compulsory licensing provisions that we recommend will make it possible for the applicant to secure the right to use these improvements even though they are patented, providing he is willing to make available his own invention to the owner of the patent on the improvements and provided the other conditions set out in the compulsory licensing section are met."

The commission points out that the new Patents Act it recommends would set no limit on the number of patents of addition which could be obtained.

Canadian Radio Patents Limited unaffected

Canadian Radio Patents Limited got a clean bill of health for its use of its patents portfolio from the Ilsley Royal Commission on Patents. But it offered a warning against any possible abuse of such portfolios.

In its report, the commission says:

"CRPL as it is now organized and as it now operates does not appear to us to be illegal. It is not illegal to acquire a portfolio of patents either by way of ownership of the patents or by way of acquiring a right to grant licenses.

"The mere control of a sector of industry through the accumulation of patents is not itself illegal.

"The complaint against CRPL is that it refused to grant a license to import. In refusing to grant such a license, CRPL was not going beyond its legal right when manufacture was taking place in Canada pursuant to licenses granted by it in this country at reasonable royalty rates.

"However, there is inherent in the accumulation of patents in respect of a sector of industry the possibility that the portfolio will be used to the public prejudice."

But after examining the legal remedies already available to combat any such abuse, the commission said evidence before it did not indicate misuse of a patent portfolio was likely to warrant any new sanctions, "other than a compulsory license at the instance of any person interested in the circumstances described by section 30 of the Combines Investigation Act."

Essentially, section 30 empowers the Exchequer Court to order a patent license, if it is shown that patent rights have been used in restraint of trade.

(Continued on page 52)

Measures 1mv to 1000v from 10 cps to 250 kc

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Also available in 9½ and 19 inch relay rack models

This instrument is an improved version of Ballantine's original Model 300, famous for its accuracy, sensitivity, and reliability for more than 20 years.

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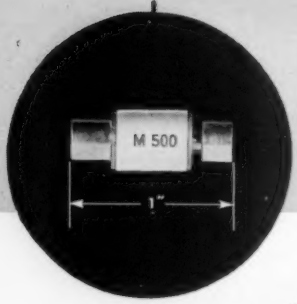
TARZIAN M-500...

a high efficiency silicon rectifier commercially priced



500-ma ferrule rectifier connects easily to standard clips

The Sarkes Tarzian M-500 silicon rectifier is rated at 500 milliamperes dc, with a peak inverse voltage rating of 400 volts. This was the first commercially priced silicon rectifier, and more M-500's are now in use than any similarly rated unit.

The Tarzian M-500 is a cartridge type rectifier with end ferrules that snap quickly and easily into standard clips. These silicon rectifiers are made by a special Tarzian process that provides optimum forward to reverse ratios and long, useful life.

For additional information, practical application assistance, and prices on the M-500, write to Section 4393 I, Semiconductor Division, Sarkes Tarzian, Inc., Bloomington, Indiana.

M-500 Characteristics

DC amps (100° C)	Peak Inv. Voltage	Tarzian Type	Max. RMS Volts	Max. Recurrent Peak Amperes (100° C)	Max. Surge Amps 4MS	JEDEC No.
0.5	400	M-500	280	5	30	1N1084

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Patents — continued

The commission said Canadian Radio Patents Limited was incorporated in 1926 to act as a patent licensing agency. It was owned by five shareholders: Canadian General Electric Company Ltd., Canadian Westinghouse Company Ltd., Northern Electric Company Ltd., Canadian Marconi Company and Canadian Radio Manufacturing Company.

In addition to acting as central patent licensing agency in the administration of patent rights in the radio, television and general electronics fields on patents owned by these companies, it also acted in Canada for RCA Victor Company Ltd. and Hazeltine Electronics Corporation.

"The evidence establishes that no one intending to carry on manufacturing operations in Canada was refused a license in respect of all patents contained in the portfolio," the commission said.

But it added:

"The portfolio in respect of which CRPL had the right to grant licenses consisted of 5,000 patents, and in the absence of a license from CRPL it is doubtful if anyone could sell in Canada a radio or television receiver."

The main concern CRPL expressed to the commission was that patent legislation might result in the grant of a compulsory license that would give an exclusive right of manufacture. It was itself prepared to grant a non-exclusive license for a reasonable royalty.

The commission said that if its recommendations are carried into legislation, "CRPL and any holder of a portfolio of patents will have the right but not the obligation to grant a license to import where the circumstances warrant, without fear of an exclusive license." It favors a provision that a compulsory license be granted only on a non-exclusive basis.

As far as controlling any possible abuse of a patent portfolio is concerned, the burden of the commission's recommendations on this point are that it should be viewed from anti-combines law provisions, rather than dealt with in patent law except for the compulsory licensing provision.

"Sanctions which now exist (against such abuses) will be found in the provisions of Sections 2 and 32 of the Combines Investigation Act and Section 411 of the Criminal Code. Section 30 of the Combines Investigation Act provides a civil remedy at the instance of the Attorney-General.

"The nature of these remedies . . . is not, in our opinion, sufficiently all-inclusive.

"We believe that where a pool or

licensing agency in control of a portfolio in practice, operates to the detriment of the public that a civil remedy ought to be available in the hands of an individual affected thereby.

The remedy could take the form of a compulsory license with a reasonable royalty, a dedication of the patent, a royalty-free compulsory license or, in lieu of the above relief in compulsory license proceedings, relief of a similar kind by way of a defence in a patent infringement action."

But the commission favors the remedy of a compulsory license with a reasonable royalty. It explained that it expects the compulsory license provisions of the new Patents Act it proposes would, "in appropriate circumstances, assure to domestic producers opportunity, on reasonable terms, to exercise rights which, but for these provisions, they might otherwise be denied."

As the commission sees it, the weakness of the present Patents Act is that one of its main purposes is the establishment of new facilities in Canada for the use of new inventions. The act proposed by the commission would try to ensure that the use of new inventions in Canada can't be hindered merely because of patent limitations on their use.

"Whether or not actual working (of new inventions) would take place would, as we conceive it, depend on where the public interest lies . . .

"We are firmly of the opinion that whether production is to occur in Canada or not should not depend simply on the decision of the patentee."

The commission said the effect it hopes will come of its proposals is:

"The rights under patents will be potentially available to persons able and willing to work inventions in Canada, and whether or not capital and labor should be applied to their working will depend on such considerations as would normally affect such a decision in the absence of any patent rights.

"We see no particular merit in attempting, by a bias in our legislation, to direct investment to the working of new inventions.

"Either, we believe, the public interest will best be served if investment finds its way into the most productive fields available rather than being artificially diverted into exploitation of new inventions where the value of the enterprise to the economy is doubtful."

In other words, the right to exploit an invention would be available for exploitation when it was worthwhile to do so. It would not be necessary to begin working an invention within a certain time limit in order to have a right to exploit it at a more profitable future time. END

The temperature of things is so important to some people that a few degrees one way or another is a calamity: it has to be plus or minus a few *tenths* of a degree, or else. This group includes Deutsche beer drinkers, those who watch over crystal oscillator ovens, certain environmental test boxes, delay lines, and the Miami* tourist trade. To them, we offer a solution.

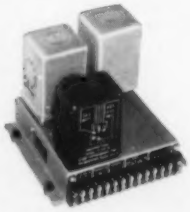
It's a Sigma Magnetic Amplifier Relay, one-half of a resistance bridge, and a built-in DC power supply — all neatly packaged and ready to go as soon as a thermistor and reference resistor are connected to complete the bridge. In operation, a temperature change unbalances the bridge, energizing the relay through the magnetic amplifier. What you do with the relay output — for corrective action or indication — is up to you. (The contacts are SPDT and available for switching 1 amp. or 5 amp. loads.)

The reason you supply the thermistor is that you know how much mounting space there is, what temperature range has to be monitored, and how much power the thermistor can safely dissipate. The woods are full of thermistor suppliers and the "Series 8000 Thermistor Temperature Control" Bulletin contains a useful guide to thermistor selection.

Compared to other ways you could detect and do something useful with changes as small as 0.1°C, this device is guaranteed free of locking contacts, delicate mechanisms and other life-shortening elements. It also provides resettable control, as well as accurate "remote" control even when fairly long leads from the thermistor are used.

Since this temperature control is about 83% magnetic amplifier, this seems like a good place to give a plug to Sigma Magnetic Amplifier devices in general. We can sell you regular and souped-up 60 cycle models, and have in development a 400 cycle type in a hermetically sealed case. All are rugged, microwatt-sensitive switches particularly useful as current, voltage or resistance comparators for monitoring or controlling light intensity, radiation level, pressure, vacuum, line voltage, etc. Bulletins on any are available on request.

*In South Braintree, the temperature today is 270°K.



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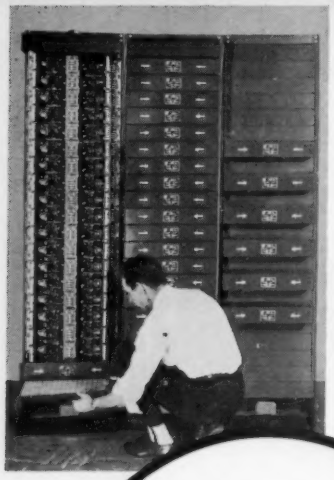

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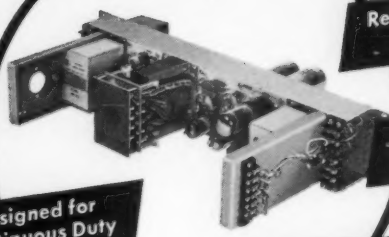

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RFL Model 912 Operates over Wire Circuit or Microwave

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The Model 912 Comvor, an audio frequency shift terminal, is used in the transmission of telemeter, telegraph or control signals over either wire line, microwave, or carrier. Up to 90 individual information channels are available in the audio spectrum.

Reliable frequency shift method of keying is used. All essential controls such as transmitter output level and receiver input level are included.

Each terminal contains its own power supply which provides an additional 60 milliamperes at both the transmitter and receiver for the operation of relays, stepping switches, selector magnets, and other components used in telemetering, control and telegraph applications.

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Defence contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parentheses indicates the number of contracts, the amount being the total value.

March 1-15, 1960

- Airtron Canada Ltd., Toronto, components, $33,613.
- Computing Devices of Canada Ltd., Ottawa, equipment, $332,821 (2).
- E.M.I. — Cossor Electronics Ltd., Halifax, establishment of production facilities for electronic equipment, $125,000.
- Electromechanical Products, Agincourt, Ont., radiometer and electronic equipment, $16,893.
- Fleet Manufacturing Ltd., Fort Erie, Ont., equipment, $21,543.
- Garrett Manufacturing Corp. of Canada Ltd., Rexdale, Ont., initial production requirements for air data computer system, $250,000.
- Instronics Ltd., Stittsville, Ont., oscilloscopes, $13,920 and telegraph equipment, $21,082.
- New Brunswick Telephone Co. Ltd., Saint John, telecommunication service, $18,616.
- R.C.A. Victor Co. Ltd., Ottawa, development of test equipment, $16,000.
- R-O-R Associates Ltd., Don Mills, Ont., equipment, $16,456.
- Stewart-Warner Corp. of Canada Ltd., Belleville, Ont., test sets, $56,493 and spares, $13,303.
- F. V. Topping Electronics Ltd., Toronto, oscillators, $44,140.

March 16-31, 1960

- Abbey Electronics Ltd., Downsview, Ont., tubes, $14,075.
- Aircraft Appliances & Equipment Ltd., Weston, Ont., instrument repair, $47,000 (2).
- Auto-Lite Batteries of Canada Ltd., Toronto, batteries, $27,208.
- Aviation Electric Ltd., Montreal, instruments, $29,332 and instrument repairs, $4,060,000 (2).
- Aviation Electric Pacific Ltd., Vancouver, instrument repairs, $185,000.
- Bayly Engineering Ltd., Ajax, Ont. tubes, $12,620.
- Beatty Bros. Ltd., Fergus, Ont., antenna towers, $41,811.
- Brunswick-Balke-Collender Co. of Canada Ltd., Toronto, repair of radomes, $50,000.
- Burgess-Battery Co., Niagara Falls, batteries, $45,190 (2).
- Canadian Applied Research Ltd.,

Toronto, instrument repairs, $1,781,-647.

- Canadian Aviation Electronics Ltd., Montreal, publications, $65,955.
- Canadian Marconi Co., Montreal, preproduction engineering for doppler navigator, $623,906; oscillator, $11,-378 and research contract, $120,217.
- Canadian National Railway Co., Ottawa, telephone rental, $24,374.
- Canadian National Telegraphs, Ottawa, telephone maintenance, $14,-663.
- Carriere & MacFeeters Ltd., Toronto, instrument repairs, $19,160.
- Computing Devices of Canada Ltd., instrument repairs, $230,000 and equipment spares, $10,000.
- E.M.I.-Cossor Electronics Ltd., Halifax, simulators, $198,874.
- Edo (Canada) Ltd., Cornwall, Ont., sonar testing equipment, $46,054.
- Garrett Manufacturing Corp. of Canada Ltd., instrument repairs, $10,000.
- Honeywell Controls Ltd., Toronto, instrument repairs, $798,000 (2).
- Instronics Ltd., Stittsville, Ont., signal generators, $57,570.
- Instruments (1951) Ltd., Ottawa, instrument repairs, $147,400 (2).
- International Business Machines Co. Ltd., Ottawa, components for electronic data processing machines, $1,-871,122.
- National Carbon Co., Toronto, batteries, $15,254.
- Northern Electric Co. Ltd., telephone cable, $71,648.
- Perkin-Elmer (Canada) Ltd., Town of Mount Royal, Que., infrared spectrometer, $14,124.
- R.C.A. Victor Co. Ltd., Montreal, installation of radar, $95,253.
- Rogers Electronic Tubes and Components, Toronto, tubes, $40,320.
- Servomechanisms (Canada) Ltd., Toronto, intervalometers, $23,522.
- Shakeproof/Fastex, Don Mills, Ont., switches, $32,612.
- Sperry Gyroscope Ottawa Ltd., Ottawa, instrument repairs, $455,000.
- Sperry Gyroscope Co. of Canada Ltd., Montreal, modification of gyro compasses, $14,046.
- Standard Telephones & Cables Mfg. Co. (Canada) Ltd., Montreal, transmitters, $80,012.
- F. J. Stokes Co. of Canada Ltd., Toronto, vacuum impregnator, $13,-182.

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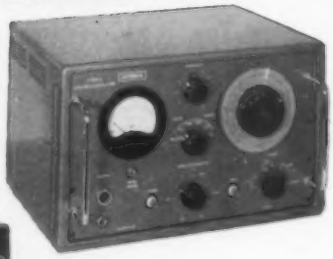

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Frequency: 200 c/s to 650 kc/s.
Accuracy: 2%
Output (OSC): 2.5 v into 600 ohms.

D-880-A (2-phase)
Frequency: 0.01 c/s to 11.2 kc/s.
Accuracy: 0.2% above 5 c/s; 2% at 0.01 c/s.
Outputs: 10 v into 10k ohms and 600 ohms.

Models cover a frequency range from 0.01 c/s to 650 kc/s

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Telephones: 3717 & 3718

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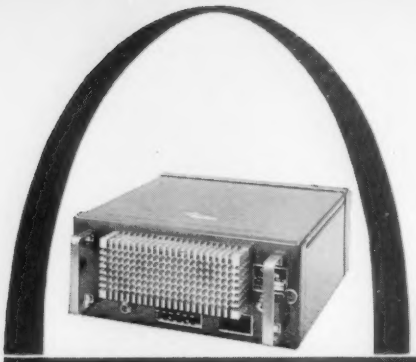

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Mobile units with the equivalent power of a conventional base station.

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through use of high precision low drift crystals.

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Now manufactured in Canada . . . ERD-Du Mont "300" series mobile systems are designed to provide high power mobile communication in the 144-174 Mcs band. In addition to high output, Du Mont systems provide clear reception at maximum working distance. New electrical features give top-efficiency operation, lowest maintenance, long service life. Get the facts about the Du Mont "300" series . . . built to meet the requirements of highest quality performance regardless of conditions.

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New products — cont.

Potentiometer recorder 118

A new laboratory model of Bristol's Dynamaster potentiometer recorder can be used to measure such variables as pressure, temperature, motion, flow, pH, and electric power. The four-position input selector switch provides for millivolt, volt, microampere, or milliampere input. The five-position span selector offers ranges 0-2, 0-5, 0-10, 0-25, and 0-50. An alternate span continuously adjustable from 0-2 to 0-50 is available.

The Bristol Co. of Canada Ltd., Toronto.

Transistorized intercom 119

Fonex provides an advanced type of transistorized intercommunication for offices, institutions, etc. It operated directly from the 110-volt supply and features push-button operation. Another feature is a locking lamp memo signal

from executive station calls; this memo may be left on or released at will. The equipment may be leased or purchased.

Telecom Ltd., Toronto.

Facsimile tape recorder 120

Series D-944 facsimile tape recorders are intended for use at relay stations handling facsimile transmissions where direct relaying is impossible due to no through-line being available at the time, or radio conditions being unsuitable. The recorder is used to store facsimile signals which are retransmitted later when conditions permit.

The equipment can also be used to store a received signal, simultaneously with its reception on a normal receiver. If the received picture is spoiled due to handling, processing or any other cause, the stored signal can be replayed and received again.

Muirhead Instruments Ltd., Stratford, Ont.

Power relay 121

A new 10 ampere dpdt hermetically sealed relay, model FC-215, has been designed for use under conditions of high shock and vibration. It has a balanced armature and contact rating of 10 amperes resistive to 26.5 vdc. Oper-

ating voltage is 18 vdc over the temperature range of —65 C to +125 C. It can withstand 30 G vibration to 2000 cps.

Struthers-Dunn Relays, Division of Renfrew Electric Co. Ltd., Toronto.

Telephone cords 122

Nylon is now being used in these new telephone station cords to reduce size and failure rate. The substitution of nylon for cotton is in the supporting core for the tinsel ribbons and the knitted binder under the PVC insulation of the conductor. New cord tips with smaller shanks are also used.

Northern Electric Co. Ltd., Montreal.

Wiring duct 123

Rounded edges on wire slots are used on Panduit open-slot electrical wiring duct. Rounded edges are furnished on both inside and outside surfaces to provide protection to insulation on wires. The duct is made of tough, non-flammable plastic and is approved by the Canadian Standards Association. It is available in sizes ranging from 4 in. x 3 in. down to ½ in. x ½ in. It can be supplied with wire holes, closed slots, or with the open slot design in standard lengths of 5 or 5 feet.

Panduit Corp., Midlothian, Ill.

Digital tape transport 124

400,000 characters/sec. transfer rate is featured by the redesigned Potter Instrument Co. model 906 (Mk-11) magnetic tape transport. This is achieved with complete program freedom at 120 inch/sec. with 10½ inch reels of 1-inch-wide tape and 16 channels. The new transport design includes a redundant guide system and an improved braking mechanism, both contributing to minimum tape wear. A non-adjustable, fully interchangeable head mounting assures precise tape alignment at all times.

Instronics Ltd., Stittsville, Ont.

Nickel-alkaline batteries 125

Edison nickel-alkaline storage batteries are now being manufactured in Canada by CLM Industries. The batteries are designed for materials handling vehicles, mine locomotives, railway passenger cars and signal equipment.

CLM Industries, Toronto.

(Continued on page 58)

SALES ENGINEER

POSITION OPEN for sales engineer on top flight instrumentation. Sales experience and engineering degree an asset but not necessary. Salary open. Send or phone full résumé to: Allan Crawford Associates Ltd., P.O. Box 214, Willowdale, Ontario. Telephone BA. 5-7391.

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announces a **FIRST** *in medium power resistors manufactured in Canada*

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3. Extremely rugged and durable properties?
4. Low cost with great reliability?
5. Sizes of 4, 6, 8 and 10 watts?
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The Welwyn F Series power resistors are composed of a metal oxide element, bonded to a porcelain rod at red heat. This process results in a resistor which is extremely rugged, both electrically and mechanically.

The durable coating which is applied is intended to provide an insulating cover rather than to protect the element which in itself is highly resistant to mechanical damage and effects of moisture.

Comprehensive tests have proved that operating these resistors under the most arduous conditions will not cause failure.

For further information write for data sheet W-1014.

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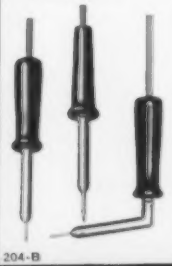
Designed with 50 watt input, these fine soldering irons will give greater productivity and do industry's most exacting soldering jobs easier, faster, better. SLOTTED STAINLESS STEEL CASINGS MAKE THE HANDLES REALLY COOL, ending operator complaints. There's no waiting or fumbling with these light, flexible tools — they're always ready. American Beauty soldering irons are known the world over for their dependability, durability and efficiency. Learn more about these fine soldering tools today.

YOU CAN'T BEAT A SOLDERED CONNECTION

WRITE FOR DESCRIPTIVE CATALOG SHEET, FORM NO. 222-CT

Shown below are other shapes and tip-size irons available in the BANTAM "X" series.



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New products — cont.

Revolution counter 126

Atcotrol series 307, shaft-driven revolution counters count shaft revolutions up to 1000 rpm and require only 1¼ ounce-inch torque for dependable electrical control of a machine or system operation. Repeatability is ±0.0025 of dial range. With its clutch energized by external momentary or sustained switch contact, the counter will indicate revolutions of a machine drive shaft until a predetermined dial setting is reached, tripping the heavy duty spdt control contact. Counters are available for ac or dc operation with eleven dial ranges from 0-12 to 240,000 revolutions, and in numerous circuit arrangements which permit adaptability to almost any process.

Automatic Timing & Controls, Montreal.

Preamplifier and monitor 127

A new instrument which combines the function of a preamplifier and monitor for low level signals is being manufactured by Waterman Products Co. It is Panelscope model P1B1X12. The preamplifier features a high impedance balanced input with a sensitivity of 3 mv rms and a 1 volt rms output (for tape recorders and similar devices) when the monitoring scope shows a one inch signal. The 1 volt output impedance is approximately 500 ohms. Although the output is ordinarily single-ended, a balanced 1 volt rms output may be optionally supplied. The amplifier has a bandwidth of 30 Kc. Repetitive sweep frequencies of 0.5, 1, 2, 4 cps, 1 Kc and 5 Kc are selected by a front panel control. Internal sync is provided.

Aviation Electric Ltd., Montreal.

Hot wire anemometer 128

The Flow Corp. model 54A1 hot wire anemometer gives a continuous measurement of the mass velocity of air. To get a velocity reading it is only necessary to insert a probe containing a sensing unit into the air stream. The velocity is then read directly on the meter. If desired, a recorder can be utilized to provide a continuous record of the air velocity over any period. Model 54A1 measures average and instantaneous velocities in the flow of air by making use of the cooling effect of the stream on a thin electrically heated wire filament. A completely transistorized circuit maintains constant the resistance ratio of a hot and cold filament. The standard range is 0 to 4000 fpm on three scales.

Radionics Ltd., Montreal.

Electron microscope 129

The Tesla table-type electron microscope model BS 242A is an electromagnetic transmission type microscope consisting of an optical system, high tension power supply, storage battery for energizing the lenses, and a rotary vacuum

pump. Operational resolution is better than 50 Angstroms with magnification adjustable in steps from 1000x to 30,000x. High tension is 60 kv. Input power requirements are 220 v, 50 cps, single phase. Consumption is approximately 1.4 kva.

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5 5/8" long
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High frequency resistor 130

A new line of fast rise time precision wire-wound resistors has been designed for use in high frequency circuits. They are non-inductive and non-capacitive. A 1 megohm resistor has a capacitance of only 0.5 pf.

Available in a range of 10 ohms to 1 megohm, the resistors can be supplied to tolerances as close as 0.1%. Sets of values or ratios can be matched to within 0.01%. Standard temperature coefficient is 15 parts per million per deg. C.

Ultronix, Inc., San Mateo, Calif.

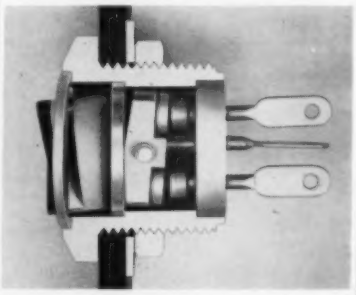
Image orthicon tube 131

This extended-life image orthicon tube for tv cameras uses a new target material and new processing to virtually eliminate image retention and its limiting effect on operating life. The new type WL-7611 tube has a 1000-hour warranty. The tube also has low susceptibility to raster burn and the camera can be focused on a stationary scene for several minutes without permanent damage. The WL-7611 orthicon is directly interchangeable with the 5820 orthicon and has identical performance characteristics, except for the former's higher level of sensitivity over a longer life.

Canadian Westinghouse Co. Ltd., Hamilton.

Magnetic switch 132

The FluxLink electrical switch, actuated by a permanent magnet, will operate reliably and safely under adverse conditions encountered in space flight, underwater operations and in explosive or corrosive atmospheres. Magnetic flux



is transmitted through a solid metal barrier into a sealed chamber containing the make and break electrical contacts. Snap action is provided by the flux, eliminating the conventional springs.

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Space Components, Inc., Washington, D.C.

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Now you can try the famous 960*
Transistor and Crystal Diode Tester
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*and convince yourself that you won't find a unit comparable to this **PRECISION** instrument for your electronic maintenance requirements*

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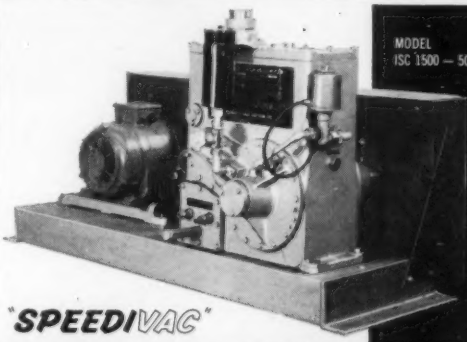

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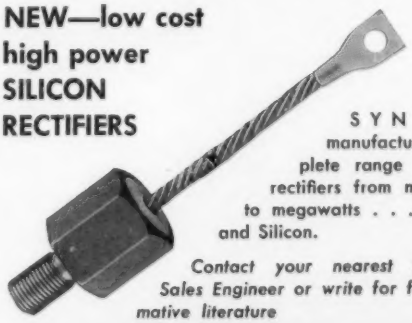

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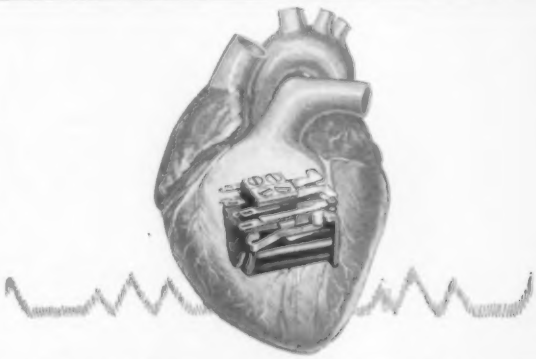

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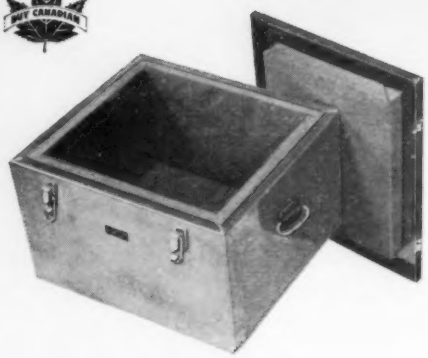

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Quality Instruments
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Wired and Unwired

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Dominion Electrohome unveils its new electronic organ

After more than a year of intensive design work, Dominion Electrohome Industries Ltd. has introduced its new "Allegro" electronic organ. It is a medium-priced ($895) instrument suitable for use in small auditoriums and churches as well as in the home.

Designer Heddink shows circuits to Design Engineering editor D. Kaill.

In introducing the new instrument, C. A. Pollock, Electrohome's president, pointed out that there were less than 800 electronic organs sold in Canada in 1957, but more than 3,000 were sold in 1958. He also pointed out that his company plans to explore the market with the Allegro, then introduce two more models later on. One will be a two-manual organ, and the other will be a chord organ.

The Allegro is a one-manual organ with 48 notes on the keyboard and 13 on the pedal claviar. It has six voices—diapason, reed, flute, string, horn and clarion. Volume can be controlled by means of the rotating stop knobs or by a crescendo pedal.

The engineer who designed the Allegro obviously enjoyed his assignment. J. Heddink, born and raised in Holland, comes from a family of musicians. He is an accomplished pianist and violinist, as well as an electronics engineer.

CEE will publish a technical paper on this new electronic organ in a future issue.

Nuclear structure conference

A conference on nuclear structure will be held at Queen's University, Kingston, Ont., from August 29 to September 3, 1960. It is being sponsored by the International Union of Pure and Applied Physics, the National Research Council of Canada, Atomic Energy of Canada Ltd., and Queen's University. Topics are restricted to information about nuclear structure, and emphasis will be placed on experimental data and their interpretation.

Invited speakers for sessions will act as rapporteurs. Each speaker will introduce his subject and discuss the work of the contributors who have submitted communications on that subject. Some sessions may be devoted to individual presentations.

Enquiries about the conference and requests for registration forms should be sent to Dr. L. G. Elliott, Atomic Energy of Canada Ltd., Chalk River, Ont.

A. Mean, left, field day co-ordinator and past president of Nortown Amateur Radio Club VE3NAR, accepts Canadian Marconi Trophy from H. E. Buchanan. Club made most contacts during simulated emergency test.

Engineering seminars

The Industrial Engineering Institute is conducting a number of short seminars during May, June and July. These cover a variety of subjects of interest to engineers, and several seminars are being held in Toronto and Montreal. Only the latter are listed below; for a full list of subjects, dates, places and fees, write to Industrial Education Institute, 25 Huntington Ave., Boston 16, Mass.

(A) Reducing costs in drafting and design operations, Montreal, May 4; Toronto, May 5. (B) Calculating return on proposed projects or plant facilities, Toronto, May 26; Montreal, May 27. (C) Locating and developing creative engineers, Montreal, June 1; Toronto, June 3. (D) Controlling and reducing clerical costs, Montreal, June 7; Toronto, June 8. (E) Clear technical writing, Montreal, June 7; Toronto, June 9.

Correction

The Montreal Section of the Institute of Radio Engineers has extended the deadline for papers for their communications symposium. The new deadline for paper titles and 50-word summaries is June 1, 1960. These should be sent to C. F. Kipp, Chairman, Technical Program Committee, IRE Symposium on Communications, Box 802, Station "B", Montreal, P.Q.

The symposium will be held in Montreal on Nov. 4, 5, 1960. Information regarding exhibits will be sent to industry members shortly.

COMING EVENTS

May

2-4 National Aeronautical Electronics Conference, Dayton, O.

3-5 8th Annual Conference on Electromagnetic Relays; National Association of Relay Manufacturers, Stillwater, Oklahoma.

9-13 Annual Conference of the Society of Photographic Scientists and Engineers, Miramar Ho-Los Angeles.

23-28 3rd International Instruments, Electronics and Automation Exhibition, Olympia, London.

June

6-7 2nd Conference of the Computing and Data Processing Society of Canada, University of Toronto.

6-8 3rd Canadian National Business Show, Automotive Building, Toronto.

Directory

The CEE Components and Equipment Directory will have a new look this year. Product classifications have been streamlined and cross-referenced to make it easier than ever for engineers to locate those elusive parts they need. Watch for this new edition of the directory in June.

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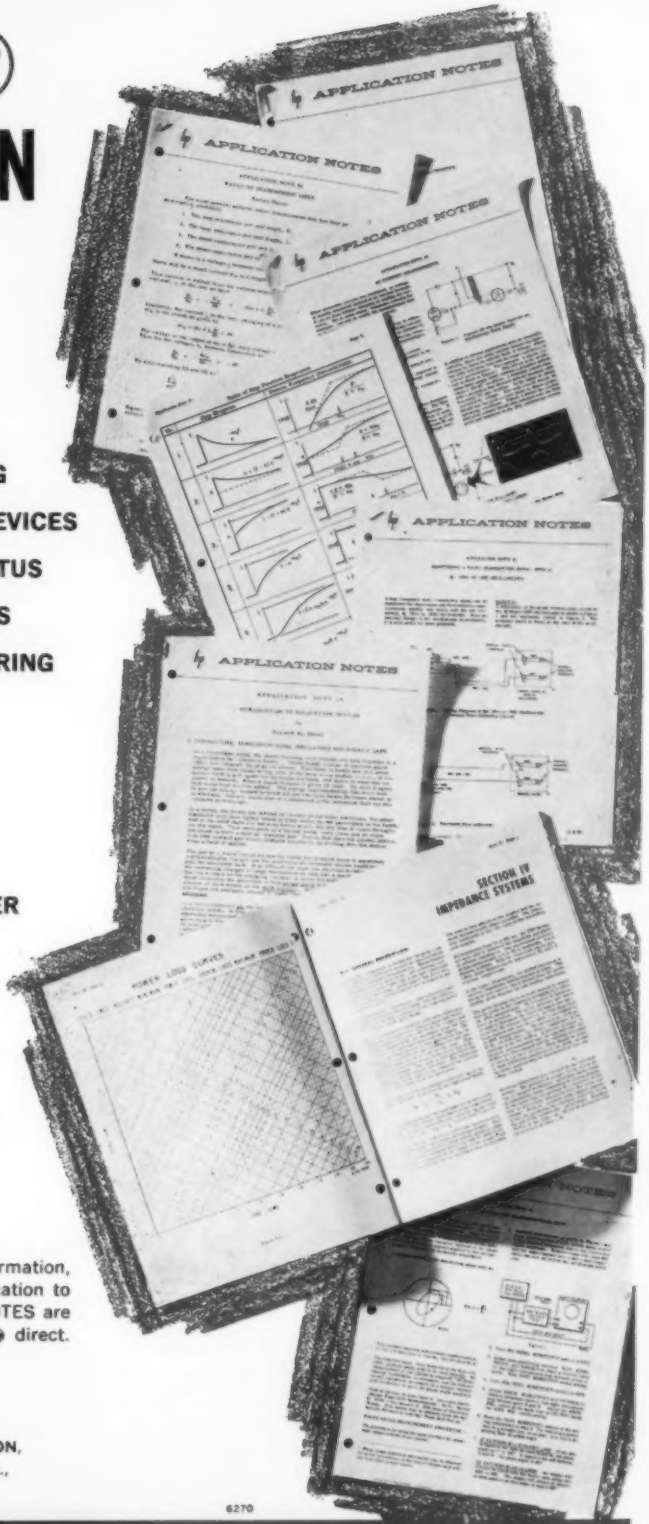

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